BART-San Francisco Airport Extension
Draft Environmental Impact Report/
Supplemental Draft Environmental Impact Statement

Air Quality Technical Report

Prepared for:

BART / SamTrans

Prepared by:

Ogden Environmental and Energy Services Company

221 Main Street, Suite 1400
San Francisco, CA 94105

December 1994

Table of Contents

		PAGE
1.	**INTRODUCTION**	**1-1**
1.1	Purpose of Report	1-1
1.2	Organization of Report	1-1
2.	**NEPA/CEQA AIR QUALITY SIGNIFICANCE CRITERIA AND PROJECT CONFORMITY REQUIREMENTS**	**2-1**
2.1	NEPA/CEQA Significance Criteria	2-1
2.2	Air Quality Conformity Requirements	2-2
2.2.1	The Bay Area Air Quality Plan and the MTC Resolutions on Conformity	2-3
2.2.2	EPA Conformity Regulations	2-3
3.	**ANALYSIS OF CONSTRUCTION IMPACTS**	**3-1**
3.1	Methodology	3-1
3.2	Results	3-2
4.	**ANALYSIS OF REGIONAL AIR QUALITY IMPACTS**	4-1
4.1	Methodology	4-1
4.1.1	Regional VMT Data	4-1
4.1.2	Vehicular Pollutant Emission Factors	4-2
4.1.3	Regional Emissions Estimates	4-3
4.2	Results	4-3

5.	**ANALYSIS OF LOCAL CARBON MONOXIDE IMPACTS**	**5-1**
5.1	Introduction	5-1
5.2	General Techniques	5-1
5.3	Background Concentrations	5-1
5.4	Travel Demand Forecasting and Definition of Affected Area	5-2
5.4.1	Travel Demand Forecasting	5-4
5.4.2	Definition of the Area Substantially Affected by the Project	5-4
5.5	Roadway Intersection Analysis Methodology	5-5
5.5.1	Selection of Intersections for Analysis	5-5
5.5.2	Dispersion Model Selection	5-7
5.5.3	Vehicular Emission Rates	5-8
5.5.4	Meteorological Inputs	5-13
5.5.5	Intersection Geometry	5-16
5.5.6	Traffic-Related Inputs by Intersection Type	5-17
5.5.7	Receptor Locations	5-28
5.5.8	Impact Estimation	5-29
5.6	Parking Area Analysis Methodology	5-34
5.6.1	Selection of Parking Areas and Analysis Year	5-34
5.6.2	Dispersion Model Selection and Description	5-35
5.6.3	Vehicular Emission Rates	5-35
5.6.4	Meteorological Data	5-36
5.6.5	Traffic-Related Inputs	5-36
5.6.6	Parking Area Geometry	5-36

TABLE OF CONTENTS (CONTINUED) — PAGE

5.6.7	Receptor Locations	5-36
5.6.8	Model Sensitivity to Input Assumptions	5-37
5.6.9	Impact Estimation	5-37
5.7	Results	5-38
5.7.1	Intersection Analysis	5-38
5.7.2	Parking Area Analysis	5-38
5.7.3	Conformity Discussion	5-38
6.	**REFERENCES**	**6-1**

List of Tables

		Page
2-1	BAAQMD Attainment Status and EIR Significance Thresholds	2-2
3-1	Estimated Total Construction Emissions	3-3
4-1	Regional Composite Vehicular Emission Factors (g/mi)	4-4
4-2	Regional Vehicle Miles Traveled and Estimated Pollutant Emissions	4-5
4-3	Proposed Project – Locally Preferred Alternative (LPA): Net Regional Emissions	4-6
5-1	Ambient Air Quality Summary: Redwood City and San Francisco Monitoring Stations	5-3
5-2	Background CO Concentrations	5-4
5-3	BART Alternatives Included in Traffic and Microscale CO Analyses	5-6
5-4	Roadway Intersections Selected for Microscale CO Analysis	5-7
5-5	Composite CO Emission Factors (g/mi)	5-10
5-6	Daily Vehicle Miles Traveled (VMT) by Vehicle Category: San Mateo County	5-14
5-7	Meteorological Values Used in Microscale CO Analysis	5-15
5-8	Deceleration Times	5-20
5-9	Intersection Signal Type and Arrival Type	5-25
5-10	1993 Cumulative CO Concentrations	5-39
5-11	1998 Cumulative CO Concentrations	5-40
5-12	2000 Cumulative CO Concentrations	5-41
5-13	2010 Cumulative CO Concentrations	5-42
5-14	Microscale CO Analysis: BART Parking Areas	5-44

List of Figures

5-1	Distribution of Transient Starting Emissions (Caltrans, 1989b)	5-12
5-2	CALINE4 Receptor Locations	5-30
5-3	CAL3QHC Receptor Locations	5-31

List of Attachments

A	Construction Fleet Data	A-1
B	Regional VMT Data and Mileage Growth Factors	B-1
C	Top 20 Intersections by EPA Ranking Procedure	C-1
D	Alternative-specific Intersection Traffic and Geometry Information	D-1

BART-San Francisco
Airport extension :
1994.

1. INTRODUCTION

1.1 Purpose Of Report

This Air Quality Technical Report presents the detailed methodology used in the air quality impact analysis conducted for the BART–San Francisco Airport Extension Draft EIR/Supplemental Draft EIS. In addition, this report is intended to serve as the complete project-specific conformity analysis pursuant to United States Environmental Protection Agency (EPA) conformity regulations at 40 CFR 93 (EPA, 1993d), Metropolitan Transportation Commission (MTC) Resolution No. 2270 (MTC, 1991a), including appendices, and the associated *Project Sponsor Guidance and Checklist for Carbon Monoxide Analysis Performed for Conformity Assessment for Transportation Projects* (MTC 1991b).

1.2 Organization Of Report

This report is organized in six sections, followed by a series of attachments. The air quality impact significance criteria established for the project are identified in Section 2, which also includes a discussion of the criteria for demonstration of conformity for a transportation project. Sections 3 and 4 present the methodology for estimation of construction impacts and regional air quality impacts, respectively. Section 5 discusses the local carbon dioxide (CO) impact analysis; it describes the technical approach in relation to EPA microscale CO modeling guidance, and also includes the information requested by the MTC in the conformity guidance document for Resolution No. 2270. References are included as Section 6. Attachments follow Section 6.

2. NEPA/CEQA AIR QUALITY SIGNIFICANCE CRITERIA AND PROJECT CONFORMITY REQUIREMENTS

2.1 NEPA/CEQA SIGNIFICANCE CRITERIA

The BART–San Francisco Airport Extension Draft EIR/Supplemental Draft EIS has been prepared pursuant to the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). This legislation requires project sponsors to prepare a document that describes the potential effects of the project, particularly those considered "significant." This section presents the significance criteria for the air quality effects of the project.

The Bay Area Air Quality Management District (BAAQMD) significance criteria for a project or plan are defined in *Air Quality and Urban Development – Guidelines for Assessing Impacts of Projects and Plans* (BAAQMD, 1985; revised 1991). Significance criteria for this project have been adapted from the BAAQMD criteria, based on discussions with the BAAQMD and the Metropolitan Transportation Commission (MTC), to more closely relate to the current regulatory framework.

Significance criteria are defined for the following pollutants: ozone precursors (oxides of nitrogen (NO_x) and reactive organic gases (ROG)), particulate matter less than ten microns in diameter (PM_{10}), carbon monoxide (CO), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2). For the proposed project alternatives, air quality impacts will be considered significant:

- For non-photochemically reactive pollutants (CO and PM_{10}), if project-specific emissions cause ambient air levels which, when added to background, result in a violation of a state or federal ambient air quality standard.
- For nonattainment pollutants (CO, O_3, and PM_{10}), if the net increase in regional emissions due to the project exceeds the applicable BAAQMD threshold in effect at the time of project approval. The threshold represents the level above which the BAAQMD requires the use of best available control technology (BACT) and/or the provision of offsetting emission reductions in order to obtain a permit for a new or modified stationary source. While not specifically applicable to transportation projects, this level represents the most conservative (lowest) emission level that could be considered significant for nonattainment pollutants. For O_3, the numerical emission offset threshold is applied to precursors measured as oxides of nitrogen (NO_x) and reactive organic gases (ROG).
- For attainment pollutants (NO_2 and SO_2), if the net increase in emissions due to the project exceeds 150 lbs/day, the level established by the BAAQMD (1985).

Table 2-1 shows the numerical values associated with these significance criteria.

Table 2-1
BAAQMD Attainment Status and EIR Significance Thresholds

Pollutant	BAAQMD Air Basin Federal Status(1)	BAAQMD Air Basin State Status(1)	BAAQMD Emission Offset or BACT Threshold(2)	Net Increase Threshold(3)
Ozone(4)	Nonattainment	Nonattainment		
NO_X (ozone precursor)	—	—	10 lbs/highest day 15 ton/year	NA
ROG (ozone precursor)	—	—	10 lbs/highest day 15 ton/year	NA
PM_{10}	Attainment	Nonattainment	10 lbs/highest day 1 ton/year	NA
CO	Nonattainment	Nonattainment	10 lbs/highest day	NA
SO_2	Attainment	Attainment	NA	150 lbs/day
NO_2	Attainment	Attainment	NA	150 lbs/day

Notes:

1) Attainment indicates that the ambient air quality in the region has attained (is below) the applicable federal or state ambient air quality standard. Nonattainment indicates that the air quality in the region does not attain (is worse than) the applicable standard.

2) Threshold is applied to the regional net increase in nonattainment pollutants; NA or Not Applicable for others. See significance criteria description.

3) Threshold is applied to attainment pollutants; NA for others.

4) Thresholds apply to the ozone precursors, oxides of nitrogen (NO_X) and reactive organic gases (ROG).

2.2 Air Quality Conformity Requirements

The 1990 Clean Air Act (42 USC 7506) provides the current framework for air conformity, defining conformity (of a plan, program, or project) to a State Implementation Plan (SIP) to mean:

> "Conformity to an implementation plan's purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards, and achieving expeditious attainment of such standards... ."

2.2.1 The Bay Area Air Quality Plan and the MTC Resolutions on Conformity

The BAAQMD is the primary local agency responsible for implementation and enforcement of state and federal air quality requirements. Federal enforcement responsibility is the result of United States Environmental Protection Agency (EPA) approval of the 1982 Bay Area Air Quality Plan (referred to as 1982 Plan), also known as the State Implementation Plan or SIP, which describes how the BAAQMD will implement federal air quality requirements. The 1982 Plan contains specific conformity provisions with regard to transportation-related actions, specifying the conditions under which transportation plans, programs, and projects will be considered in conformity with the 1982 Plan and the Clean Air Act.

As the regional transportation planning organization for the Bay Area, the MTC is responsible for establishing that the Bay Area Regional Transportation Improvement Program (TIP) (MTC, 1993b) and Regional Transportation Plan (RTP) (MTC, 1993c) conform with the SIP. In November 1990, amendments to the Clean Air Act (described below) were passed that provided new direction for reviewing air quality effects of transportation projects. In April 1991, the MTC adopted Resolution No. 2270 (MTC, 1991) in order to comply with new amendments. The objective of Resolution No. 2270 is to ensure that the air quality effects of the project conform to the SIP, and to ensure that the project is consistent with transportation control measures. The resolution contains two key appendices: *Conformity Assessment Procedures*, which the MTC has used to establish that the TIP and RTP are in conformity with the 1982 Plan and the Clean Air Act; and *Criteria for Project Conformity*, which establishes the criteria and conformity assessment procedures for individual transportation projects. Further, in response to the requirements of the EPA conformity regulation (discussed below), the MTC has prepared and submitted to the EPA the *San Francisco Bay Area Transportation Conformity Procedures* (MTC, 1994). These conformity procedures will supersede Resolution 2270 and conformity procedures contained in the 1982 Plan upon approval by the EPA for inclusion into the SIP.

In accordance with the 1982 Plan and Resolution No. 2270, the MTC criteria for project-level conformity are:

- The project must be included in a plan or program (i.e., a TIP or RTP) that has been found to conform;

- The project must eliminate, or reduce the severity and number of, violations of the CO standard in the area substantially affected by the project; and

- The project must be consistent with the 1982 Plan.

MTC Resolution No. 2270, Appendix B, establishes specific conformity assessment procedures to be applied to transportation projects in order to assess their conformity with the 1982 Plan.

2.2.2 EPA Conformity Regulations

Section 176(c) of the Clean Air Act specifies that no federal agency may support a federal action and/or federally-funded activity that does not conform to the applicable state implementation plan. Section 176(c) also includes "interim" requirements regarding conformity for transportation projects, plans, and programs, and essentially precludes federal action on non-conforming projects, plans, or programs. The Clean Air Act also requires that the EPA develop rules to ensure that federal actions conform. In 1991, the Department of Transportation (DOT) and the EPA issued guidance for determining conformity of transportation plans, programs, and projects based on the Section 176(c) language.

In late 1993, the EPA promulgated final rules for determining conformity of transportation plans, programs, and projects. The requirements of 40 CFR Part 93 (*Determining Conformity of Federal Actions to State or Federal Implementation Plans)* Subpart A (*Conformity to State or Federal Implementation Plans or Transportation Plans, Programs, or Projects Developed, Funded, or Approved under Title 23 USC or the Federal Transit Act)* govern the conformity assessment for this project. These EPA regulations specify the requirements for project conformity, and specify provisions that are applicable prior to promulgation and EPA approval of local implementing rules as part of upcoming BAAQMD revisions to the SIP. The SIP revisions are required to specify how the BAAQMD will implement the 40 CFR 93 conformity requirements (among other issues); EPA approval of the upcoming MTC/BAAQMD conformity provisions of the SIP revision will result in formal delegation of regulating authority.

In order to be found to conform under EPA conformity regulations:

- The transportation project must come from a conforming transportation plan and program (i.e., a TIP and RTP that have been found to conform);

- The transportation project must eliminate, or reduce the severity and number of, localized violations of the CO ambient air quality standard in the area substantially affected by the project. Procedures for determining the localized CO concentrations, or "hot spots," state that CO hot spots analysis must be completed using air quality models and procedures recommended by the EPA, as appropriate; and

- The transportation project must not cause or contribute to any new localized PM_{10} violations or increase the frequency or severity of existing PM_{10} violations in PM_{10} nonattainment areas. Quantitative PM_{10} impact analysis is required in some cases; however, this requirement will not take effect until the EPA releases formal modeling guidance for PM_{10} impact analysis in the Federal Register. At the time of this writing, the EPA has neither designated the Bay Area as nonattainment for PM_{10} nor issued PM_{10} modeling guidance, and therefore the air quality analysis for this project need not include quantitative PM_{10} impact analysis and this criterion does not apply.

With regards to the first criterion, the MTC has determined that the TIP and RTP conform with the 1982 Plan and the federal Clean Air Act. The BART–San Francisco Airport Extension is included in the RTP and fiscal year (FY) 1992-1996 TIP. The MTC has made findings of conformity for the RTP and TIP in relation to the 1982 Plan (MTC Resolution Nos. 2339 and 2333, respectively). The EPA and the DOT determined on November 14, 1991 that the RTP and TIP conform as required. Therefore, the BART build alternatives come from a plan and program that have been found to conform.

To address the second criterion for BART project-specific conformity, CO hot spots analysis has been conducted to evaluate localized CO impacts. To determine if each project alternative meets the conformity criteria of reducing the number and severity of local CO violations, impacts estimated for each BART build alternative are compared to those estimated under the No Build Alternative, for the analysis years 1998, 2000, and 2010, which represent years when BART will be in operation. Although the California Environmental Quality Act (CEQA) requires an analysis of the project superimposed on base year conditions (1993), conformity analysis considers only those analysis years in which the proposed project will be in operation. In those instances where no CO violations are predicted under the No Build Alternative, if there are also no CO violations under build conditions, then the project satisfies this criterion. This policy position is provided by the EPA in the preamble to the final EPA conformity rule (EPA, 1993). MTC Resolution No. 2270 contains similar language, allowing a positive project-level

conformity determination if there are no violations predicted under either the No Build or corresponding build alternatives in any future planning year.

Local CO and PM_{10} hot spot analyses are specifically *not* required to consider "temporary" construction-related activities per 40 CFR 93.131, where temporary is defined as five years or less. BART does not anticipate that construction activities will exceed a five-year duration at any individual location along the project corridor. Therefore, construction-related impacts are evaluated in the DEIR/SDEIS document as a CEQA/NEPA issue only, and the findings are unrelated to the conformity determination.

3. ANALYSIS OF CONSTRUCTION IMPACTS

This section outlines the methodology and results of the analysis for potential air quality impacts related to BART construction activities.

3.1 METHODOLOGY

Emissions associated with construction activities for the BART build alternatives have two main sources. The first source is fuel combustion by the construction equipment, which generates exhaust emissions of carbon monoxide (CO), sulfur oxides (SO_X), oxides of nitrogen (NO_X), reactive organic gases (ROG) and particulate matter. The second source is fugitive dust emissions from land disturbance (e.g. excavation and grading) and truck movement.

For each BART build alternative, specific information regarding the projected construction equipment fleet (types of equipment, number of units of each equipment type, and total hours of operation) was obtained from Appendix F of *Preliminary Construction Scenario Report* (Bay Area Transit Consultants (BATC), 1993). In some alternatives, more than one construction option was evaluated. For each type (piece) of equipment, emission factors were obtained either from *Compilation of Air Pollution Emission Factors, AP-42, Volume II* (EPA, 1985), or from *South Coast Air Quality Management District CEQA Air Quality Handbook* (SCAQMD, 1993). The latter document references *Non-Road Engine and Vehicle Emission Study* (EPA 1991). All construction equipment was assumed to be diesel-fired; this is a conservative (worst-case) assumption, since emissions from diesel-fired equipment are greater than those from gasoline- or electricity-powered equipment.

Attachment A contains a listing of the equipment fleet, hours of operation, emission factors, horsepower rating, and load factors assumed for each BART build alternative. Emissions from equipment with known horsepower rating were calculated from:

$$E_i = LF \times HP \times h \times EF_i \qquad (3\text{-}1)$$

where:

E_i = emissions of pollutant i (lbs);
LF = equipment load factor (dimensionless);
HP = equipment horsepower rating (hp);
h = hours of operation (hr); and
EF_i = emission factor for pollutant i (lbs/HP-hr).

When the horsepower rating was not provided, equipment emissions were calculated by:

$$E_i = LF \times h \times EF_i \qquad (3\text{-}2)$$

where:

E_i = emissions of pollutant i (lbs);
LF = equipment load factor (dimensionless);
h = hours of operation (hr); and
EF_i = emission factor for pollutant i (lbs/hr).

Emissions of each pollutant were summed across all pieces of equipment; the totals represent the pollutant emissions over the entire construction period. In order to estimate emissions on a pounds-per-day (lb/day) and tons-per-year (ton/yr) basis, the construction schedules provided in the BATC report were reviewed. Based on that information, an actual construction period (excluding bid package preparation, review, etc.) of 25 months was assumed for each alternative.

Fugitive dust emissions were estimated for each project alternative as follows. The total acreage in the project corridor that would be disturbed during construction was determined from the BATC report. The corridor width was estimated to be 80 feet; this represents an average value over the length of the corridor, and was assumed for all alternatives. The total acreage disturbed during construction was calculated by multiplying this estimated width by the length of the alignment for each project alternative. Conservatively, it was assumed that the total corridor acreage would be disturbed during the entire construction period. While this assumption likely overestimates emissions, review of the BATC construction schedules shows that the different phases of construction overlap, and that there is some activity along the entire corridor during the entire construction period. An emission factor for total particulate matter of 1.2 tons/acre/month was assumed, which is the standard emission factor accounting for grading and excavation types of activities for construction projects provided by the United States Environmental Protection Agency (EPA, 1985). Particulate matter less than 10 microns in diameter (PM_{10}) was assumed to be 50 percent of total particulate matter (EPA, 1985). Further, an emissions reduction was included to account for the standard practice of watering the active construction area; watering is assumed to have a 50 percent control efficiency (SCAQMD, 1993). Fugitive PM_{10} emissions were then determined from:

$$E_{PM_{10}} = EF_{TSP} \times f_{PM_{10}} \times A \times \eta \times 12 \qquad (3\text{-}3)$$

where:

$E_{PM_{10}}$ = fugitive PM_{10} emissions (ton/yr);

EF_{TSP} = total particulate emission factor (ton/acre/mo);

$f_{PM_{10}}$ = PM_{10} fraction (dimensionless);

A = corridor area (acre);

η = watering control efficiency (dimensionless); and

12 = conversion factor (mo/yr).

3.2 Results

Table 3-1 shows the estimated construction equipment exhaust emissions and fugitive PM_{10} emissions for each BART alternative. Emissions of ROG, NO_X, and PM_{10} exceed the significance thresholds presented in Table 2-1 under all construction scenarios. Therefore, construction emissions are a significant impact of each BART build alternative.

Table 3-1
Estimated Total Construction Emissions

Alternative	CO	ROG	NO_X	SO_X	Equipment PM_{10}	Fugitive PM_{10}	Total PM_{10}
	Emissions (lb/day)						
Proposed Project — Locally Preferred Alternative (LPA)	236	55	573	48	45	1,222	1,267
I-380 Least-Cost Design Option	235	53	542	46	42	1,202	1,244
Alternative I — No Build Alternative	NA	NA	NA	NA	NA	NA	NA
Alternative II — Transportation System Management (TSM)	NA	NA	NA	NA	NA	NA	NA
Alternative III — BART to Airport Intermodal (Base Case)	233	53	545	47	43	1,181	1,224
Alternative IV — Airport Aerial East of Highway 101							
with Downtown San Bruno Station	294	66	682	58	53	1,359	1,412
with aerial I-380/San Bruno Station	296	66	686	58	53	1,359	1,412
Alternative V — Minimum Length Subway to Millbrae Station							
with Tanforan Station	251	58	610	52	48	1,317	1,365
with I-380/San Bruno Station	236	55	591	50	47	1,317	1,363
with Downtown San Bruno Station	450	103	1,147	98	90	1,317	1,407
Design Option V-A — Minimum Length Subway to Airport GTC							
with I-380/San Bruno Station	346	76	768	65	60	1,425	1,485
with Downtown San Bruno Station	350	77	779	67	60	1,425	1,486
Design Option V-B — Minimum Length Subway to San Bruno							
with I-380/San Bruno Station	205	48	509	43	40	1,094	1,134
with Downtown San Bruno Station	228	53	569	48	45	1,094	1,138
Alternative VI — Millbrae Avenue via the Airport International Terminal							
with tunnel option	560	116	1,123	97	86	1,453	1,538
with relief track	492	106	1,060	91	82	1,447	1,528
	Emissions (ton/year)						
Proposed Project — Locally Preferred Alternative (LPA)	42.5	9.9	103.1	8.7	8.1	219.9	228.0
I-380 Least-Cost Design Option	42.2	9.5	97.6	8.3	7.6	216.4	224.0
Alternative I — No Build Alternative	NA	NA	NA	NA	NA	NA	NA
Alternative II — Transportation System Management (TSM)	NA	NA	NA	NA	NA	NA	NA
Alternative III — BART to Airport Intermodal (Base Case)	42.0	9.5	98.2	8.4	7.7	212.6	220.3
Alternative IV — Airport Aerial East of Highway 101							
with Downtown San Bruno Station	52.9	11.8	122.8	10.4	9.5	244.7	254.2
with aerial I-380/San Bruno Station	53.2	11.9	123.4	10.5	9.5	244.7	254.2
Alternative V — Minimum Length Subway to Millbrae Station							
with Tanforan Station	45.2	10.5	109.8	9.4	8.6	237.0	245.6
with I-380/San Bruno Station	42.4	10.0	106.4	9.1	8.4	237.0	245.4
with Downtown San Bruno Station	80.9	18.5	206.5	17.7	16.2	256.6	272.8
Design Option V-A — Minimum Length Subway to Airport GTC							
with I-380/San Bruno Station	63.1	13.8	140.2	12.0	10.8	256.6	267.4
with Downtown San Bruno Station	62.2	13.7	138.2	11.8	10.7	196.9	207.6
Design Option V-B — Minimum Length Subway to San Bruno							
with I-380/San Bruno Station	37.0	8.7	91.7	7.7	7.2	196.9	204.1
with Downtown San Bruno Station	41.1	9.6	102.4	8.7	8.0	196.9	204.9
Alternative VI — Millbrae Avenue via the Airport International Terminal							
with tunnel option	100.7	20.9	202.2	17.4	15.4	261.5	276.9
with relief track	88.6	19.1	190.8	16.3	14.7	260.4	275.1

Notes:

1) NA means not applicable; there is no construction associated with the No Build and TSM Alternatives.

4. ANALYSIS OF REGIONAL AIR QUALITY IMPACTS

4.1 METHODOLOGY

Regional air quality impacts resulting from the BART build alternatives are directly related to changes in regional vehicular traffic from the No Build Alternative. "Regional" refers to the nine-county Bay Area air basin under the jurisdiction of the Bay Area Air Quality Management District (BAAQMD). Regional vehicular emissions are based on estimates of peak-hour vehicle miles traveled (VMT) data supplied by the Metropolitan Transportation Commission (MTC) in conjunction with estimates of vehicular pollutant emissions. Regional air quality impacts are analyzed in the DEIR/SDEIS for 1993, 1998, 2000, and 2010.

4.1.1 Regional VMT Data

Regional vehicular emissions were based on regional peak-hour (the hour when VMT is greatest) VMT data (veh-mi/hr) for the years 1990 and 2010, as provided by the MTC (1993f). The MTC provided 1990 and 2010 peak-hour VMT for the proposed project and for the No Build Alternative. Additionally, the MTC provided 2010 (only) peak-hour VMT data for the Transportation Systems Management (TSM) Alternative. These data are included in Attachment B. In a subsequent conversation, the MTC provided 1990 and 2010 regional daily VMT data (veh-mi/day) for the No Build Alternative (MTC, 1994). Parsons Brinckerhoff Quade and Douglas (PBQ&D), the transportation consultant on the BART–San Francisco Airport Extension EIS/EIR, provided growth factors used to derive VMT values for the 1993, 1998, and 2000 analysis years. These data are included in Attachment B.

In order to derive a complete set of daily and peak-hour VMT data for all alternatives and analysis years, a number of assumptions were necessary. First, the percent increase in traffic between 1990 and 2010 under the TSM Alternative was assumed equal to that under the No Build Alternative. Therefore, the 1990 peak-hour VMT value for the TSM Alternative was calculated from:

$$PHVMT_{TSM,\,1990} = PHVMT_{TSM,\,2010} \times \frac{PHVMT_{NB,\,1990}}{PHVMT_{NB,\,2010}} \tag{4-1}$$

where:

$PHVMT_{TSM,1990}$ = peak-hour VMT for the TSM Alternative in year 1990 (veh-mi/hr);

$PHVMT_{TSM,2010}$ = peak-hour VMT for the TSM Alternative in year 2010 (veh-mi/hr);

$PHVMT_{NB,1990}$ = peak-hour VMT for the No Build Alternative in year 1990 (veh-mi/hr); and

$PHVMT_{NB,2010}$ = peak-hour VMT for the No Build Alternative in year 2010 (veh-mi/hr).

Peak-hour VMT values in the intervening years (1993, 1998, and 2010) were estimated for the proposed project, No Build Alternative, and TSM Alternative using the PBQ&D growth factors:

$$PHVMT_{A,y} = PHVMT_{A,1990} \times GF_y \quad (4\text{-}2)$$

where:

$PHVMT_{A,y}$ = peak-hour VMT for alternative *A* in year *y* (veh-mi/hr);
$PHVMT_{A,1990}$ = peak-hour VMT for alternative *A* in year 1990 (veh-mi/hr); and
GF_y = growth factor for year *y* (dimensionless).

Discussions with the transportation consultants (PBQ&D, 1994d) resulted in a determination that the VMT data would not differ between BART build alternatives by more than 1 to 2 percent, which was not considered significant for this analysis. Therefore, all other BART build alternatives were assumed to have the same peak-hour VMT values as the proposed project:

$$PHVMT_{BA,y} = PHVMT_{pp,y} \quad (4\text{-}3)$$

where:

$PHVMT_{BA,y}$ = peak-hour VMT for BART build alternative *BA* in year *y* (veh-mi/hr); and
$PHVMT_{pp,y}$ = peak-hour VMT for the proposed project in year *y* (veh-mi/hr).

Finally, daily VMT for each build alternative was calculated by assuming that the ratio of peak-hour to daily VMT for that alternative is equal to the ratio of peak-hour to daily VMT for the No Build Alternative:

$$DVMT_{A,y} = PHVMT_{A,y} \times \frac{DVMT_{NB,y}}{PHVMT_{NB,y}} \quad (4\text{-}4)$$

where:

$DVMT_{A,y}$ = daily VMT for alternative *A* in year *y* (veh-mi/day);
$PHVMT_{A,y}$ = peak-hour VMT for alternative *A* in year *y* (veh-mi/hr);
$DVMT_{NB,y}$ = daily VMT for the No Build Alternative in year *y* (veh-mi/day); and
$PHVMT_{NB,y}$ = peak-hour VMT for the No Build Alternative in year *y* (veh-mi/hr).

4.1.2 Vehicular Pollutant Emission Factors

Vehicular emissions factors for each pollutant were originally derived using EMFAC7F Version 1.0. As of January 1994, Version 1.0 was the most recent EPA-approved vehicular emission model for use in California. Unfortunately, Version 1.0 of the program contained an error in one of its data files, resulting in erroneous estimates of oxides of nitrogen (NO_X) emissions in several calendar years (CARB, 1994); the problem was subsequently corrected in EMFAC7F Version 1.1. On May 3, 1994, the EPA approved EMFAC7F Version 1.1, stating "during the next three months, EMFAC7F Version 1.1 should be the model of choice for conformity vehicle emissions analyses; EMFAC7F Version 1.1 must be used for conformity analyses begun after three months from today's date" (EPA, 1994a). Regional composite emission factors for the BART–San Francisco Airport Extension EIS/EIR were then newly derived using Version 1.1, to take advantage of the corrected NO_X predictions. Although the data file error affected only NO_X, Version 1.1 emission factors were used for all pollutants for consistency.

EMFAC7F calculates pollutant-specific emission factors (g/veh-mi or g/trip), for different "types" of emissions, such as hot start, cold start, and hot stabilized emissions, for specific vehicular speeds, and for project-specific temperature data assumptions. "Composite" emission factors were estimated using a vehicle mix specific to the San Francisco Bay Area region, and estimates of regional hot start and cold start percentages. The entire procedure is described in greater detail in Section 5 of this technical report. Emission factors were derived for exhaust particulate matter (PM), carbon monoxide (CO), NO_X, and reactive organic gases (ROG) (the latter two pollutants defined as ozone precursors). The EMFAC7F methodology assumes there are no sulfur dioxide (SO_2) emissions associated with vehicular traffic.

The input assumptions to the emissions model were consistent with those used by the BAAQMD and the MTC in producing the vehicular emissions budget which is currently proposed for inclusion in the upcoming SIP revision, and with those used in the most current TIP and RTP (MTC, 1993b). These assumptions and the resulting emission factors used for each forecasting year for the regional analysis for each pollutant are shown in Table 4-1.

4.1.3 Regional Emissions Estimates

Emissions associated with regional traffic were estimated using the composite emission factors (g/veh-mi) in conjunction with the daily and peak-hour VMT values described above. Regional net emissions for a given BART alternative and analysis year were calculated as the gross emissions under the alternative in the analysis year minus the gross emissions under existing conditions (the No Build Alternative in the 1993 base year):

$$E_{i,A,y} = DVMT_{A,y} \times EF_{i,y} - DVMT_{NB,1993} \times EF_{i,1993} \qquad (4\text{-}5)$$

where:

$E_{i,A,y}$ = net emissions of pollutant *i* under alternative *A* in year *y* (g/day);
$DVMT_{A,y}$ = daily VMT under alternative *A* in year *y* (veh-mi/day);
$DVMT_{NB,1993}$ = daily VMT under the No Build Alternative in 1993 (veh-mi/day);
$EF_{i,y}$ = emission factor for pollutant *i* in year *y* (g/veh-mi); and
$EF_{i,1993}$ = emission factor for pollutant *i* in year *y* (g/veh-mi).

4.2 Results

Table 4-2 shows regional daily and peak-hour VMT and the associated total vehicular emissions for the proposed project, No Build Alternative, and TSM Alternative in each analysis year. As noted above in Section 4.1, regional daily and peak-hour VMT values under the BART build alternatives are assumed to be equal to those under the proposed project. Table 4-3 presents the estimated actual and CEQA net regional emissions under the proposed project; net emissions under the other BART build alternatives are assumed equivalent to those shown here. Each of the BART build alternatives will result in a net reduction in vehicular traffic emissions, and therefore would have the effect of improving air quality at the regional level.

Table 4-1
Regional Composite Vehicular Emisson Factors (g/mi)

Pollutant	1993	1998	2000	2010
Carbon monoxide (CO)	25.02	16.17	13.55	6.33
Reactive organic gases (ROG)	1.69	1.11	0.94	0.42
Oxides of nitrogen (NO_X)	1.79	1.32	1.23	0.95
Exhaust particulates	0.10	0.06	0.06	0.05

Notes:

1) Composite emisson factors derived from EMFAC7F Version 1.1 impact rates.
2) Vehicle mix from San Francisco Bay Area Ozone Planning Inventory reports (CARB, 1993d).
3) Vehicle speed equals 25.6 mph.
4) Temperature equals 60°F for CO factors; 75°F for all other pollutants.
5) Summertime fuel blend.
6) Inspection and Maintenance (I&M) Program in effect.

Table 4-2
Regional Vehicle Miles Traveled and Associated Air Emissions

Alternative Year	Daily VMT (veh-mi/day)	Estimated Emissions (tons/yr)				Peak-hour VMT (veh-mi/hr)	Estimated Emissions (lbs/hr)			
		CO	NOx	ROG	PM		CO	NOx	ROG	PM
Proposed Project – Locally Preferred Alternative (LPA)										
1993	119.973.716	1,207,632	86,397	81,571	4,827	8,770,669	483,747	34,609	32.675	1,933
1998	137,251,189	892,868	72,887	61,291	3,313	9,582,651	341,581	27,884	23,448	1.267
2000	143.228,760	780,784	70,876	54,165	3,457	9,863,576	294.627	26,745	20,439	1,305
2010	153,198,079	390,138	58,552	25,886	3,082	10,332,100	144,175	21,638	9,566	1,139
Alternative I – No Build										
1993	120,379,907	1,211,720	86,690	81,847	4,843	8,800,406	485,387	34,726	32,786	1.940
1998	137,698,264	895.776	73,125	61,491	3,324	9,613.927	342.696	27,975	23,525	1.272
2000	143.689.980	783,298	71,104	54,339	3,468	9,895,385	295,577	26,831	20,505	1,309
2010	153,682,890	391,373	58,737	25,968	3,091	10,364,797	144.631	21,706	9,596	1.142
Alternative II – Transportation Systems Management (TSM)										
1993	119.827,198	1,206,157	86.292	81.471	4,821	8,759.979	483.157	34,566	32,635	1.931
1998	137,074,804	891,721	72,794	61,213	3,309	9,570,367	341,143	27,848	23,418	1,266
2000	143.042,043	779.766	70,783	54,094	3,453	9,850,741	294,243	26,710	20,412	1,303
2010	152.994,128	389.619	58.474	25,851	3,078	10,318.345	143,983	21,609	9.553	1.137

Notes:

1) Daily and peak-hour VMT for proposed project, No Build Alternative, and TSM Alternative provided by the Metropolitan Transportation Commission (MTC).

2) Daily and peak-hour VMT, and therefore emissions, for all build alternatives assumed equal to those for the proposed project

3) Emission factor assumptions (temperature, season, vehicle thermal states, speed) consistent with MTC TIP/RTP

Table 4-3
Proposed Project – Locally Preferred Alternative (LPA)
Net Regional Emissions

Year	Net Regional Emissions			
	CO	NOx	ROG	PM10
Net Emissions (tons/yr)				
1993	(4,089)	(293)	(276)	(16)
1998	(318,852)	(13,803)	(20,555)	(1,530)
2000	(430,937)	(15,814)	(27,682)	(1,386)
2010	(821,582)	(28,138)	(55,961)	(1,761)
Net Emissions (lbs/hr)				
1993	(1,640)	(117)	(111)	(7)
1998	(143,806)	(6,842)	(9,338)	(673)
2000	(190,761)	(7,981)	(12,347)	(635)
2010	(341,212)	(13,088)	(23,220)	(801)

Notes:

1) Net emissions calculated as regional emissions under the proposed project in the year of analysis minus regional emissions under the No Build Alternative in the 1993 baseline year.

2) Values shown in parentheses are negative (i.e. emissions under the proposed project are less than those under the No Build Alternative).

5. ANALYSIS OF LOCAL CARBON MONOXIDE IMPACTS

5.1 INTRODUCTION

This section of the Air Quality Technical Report discusses the modeling methodology used to estimate local carbon monoxide (CO) impacts at roadway intersections within the area substantially affected by the project where significant adverse CO impacts could potentially occur. The local, or microscale, CO impact analysis is intended to support 1) the analysis required under NEPA/CEQA and 2) the air quality conformity assessment required under 40 CFR Parts 51 Subpart T and 93 Subpart A and by the Metropolitan Transportation Commission (MTC) Resolution No. 2270. The methodology, assumptions, and inputs to the microscale air quality modeling are described in detail below.

The microscale CO impact analysis methodology was developed through consultation with involved local agencies and the United States Environmental Protection Agency (EPA). In September 1993, Ogden prepared an air quality impact analysis protocol that described the methodology intended for use in the air quality analysis for the project (Ogden, 1993), based on the regulatory guidance in place at that time. That protocol was reviewed by the Bay Area Air Quality Management District (BAAQMD) and the MTC. Both agencies provided comments, and the MTC additionally provided written concurrence (BART, 1993). Following promulgation of the EPA final conformity regulations in November 1993, and in response to an informal request from the EPA, Ogden prepared a revised protocol describing the intended methodology specific to the microscale CO analysis (Ogden, 1994). The revised protocol addressed the new EPA guidance for microscale CO analysis, and was submitted to the EPA, the MTC, the Federal Transit Administration (FTA), and the BAAQMD for review (BART, 1994a). Comments reflecting general concurrence were received from the MTC and the BAAQMD, and during May, June, and July 1994 both BART and the consultant team continued to correspond with the EPA with the intent of obtaining comments or formal concurrence. As of July 8, the EPA had not provided review comments, and BART proceeded with the analysis (BART, 1994b) described below.

5.2 GENERAL TECHNIQUES

The analysis of local air quality impacts focuses on CO "hot spots" resulting from vehicular traffic at roadway intersections in the area substantially affected by the project. For intersection-level analysis, a "combination" modeling approach was used to quantify CO levels in the vicinity of selected intersections: the California CALINE4 model was employed for most non-signalized intersections and for simple signalized intersections, and the EPA-recommended CAL3QHC model was employed at other intersections as described below. These models were executed using project-specific traffic data input, following appropriate model guidance. Vehicular CO emission factors input to the models were derived from the EMFAC7F model developed for use in California. The models were used to predict worst-case CO concentrations for 1-hour averaging time periods at each intersection analyzed, for all alternatives for all analysis years. Eight-hour average impacts were estimated using a persistence factor approach.

5.3 BACKGROUND CONCENTRATIONS

The MTC Resolution No. 2270 (MTC, 1991) requires identification of assumed background emissions levels and background concentrations of carbon monoxide in the area substantially

affected by the project. As local carbon monoxide concentrations are approximately linearly proportional to source strength (emission level), the following discussion considers background CO levels in the context of ambient concentrations only, rather than both ambient concentrations and emissions levels.

The BAAQMD operates a series of monitoring stations throughout the Bay Area for collection of the data necessary to evaluate local conditions against the EPA ambient air quality standards. The Redwood City station and the San Francisco station at 10 Arkansas Street are the two stations closest to the project corridor, and therefore most appropriate for defining background air quality for the project. The Redwood City station monitors ozone (O_3), CO, nitrogen dioxide (NO_2), and particulate matter smaller than 10 microns in diameter (PM_{10}). Sulfur dioxide (SO_2) monitoring data are collected at the San Francisco station. Table 5-1 presents a summary of the ambient air quality measured at the Redwood City and San Francisco air quality monitoring stations for the five-year period from 1988 to 1992.

Background CO concentrations are required for the local CO impact analysis, both for 1993 existing conditions and for all future analysis years. Determination of background CO concentrations was based on the data and methods provided by the BAAQMD (1985, revised in 1993). Background CO concentrations for 1993, 1998, 2000, and 2010 were calculated by multiplying the actual measured maximum 1989 concentration at the representative monitoring station by the most current rollback factors specified by the BAAQMD (1993).

In establishing the background CO concentrations for use in the microscale analysis, the 1989 1-hour and 8-hour second high data (the second-highest 1-hour and 8-hour average CO concentrations measured during 1989) from both the 10 Arkansas and Redwood City stations were examined. The 1989 Redwood City second high 1-hour and 8-hour CO measurements of 13.0 and 5.3 ppm, respectively, represent the greatest second high values at either station. Based on these measurements, the 1989 1-hour and 8-hour background CO concentrations were defined as 13.0 and 5.3 ppm, respectively. The background concentrations for 1993, 1998, 2000, and 2010 were calculated by multiplying these 1989 background concentrations by the BAAQMD-recommended rollback factors. Table 5-2 presents the rollback factors and the calculated background concentrations used in the local CO impact analysis.

The use of the Redwood City station data for establishing background CO levels in the project area appears appropriate based upon review of the most recent BAAQMD ambient CO concentration isopleths (BAAQMD, 1993). These 1993 background CO isopleths depict 8-hour isopleth lines of 3 ppm straddling the project corridor to the east and west, indicating a 1993 8-hour background CO concentration between 3 and 4 ppm within the project corridor. For comparison, the 1993 8-hour background CO value calculated using the rollback factor approach is 4.2 ppm.

5.4 Travel Demand Forecasting and Definition of Affected Area

The study area for the transportation impacts analysis for the BART build alternatives consists of northern and central San Mateo County, generally defined by the City of San Mateo southern city limits to the south, I-280 to the west, the San Francisco-San Mateo county line to the north, and the San Francisco Bay to the east. The BART project corridor, however, extends north only to the Colma BART Station, not to the San Francisco-San Mateo county line.

This section describes the source of the regional travel demand forecasts, and basic methodology used to develop project-specific data within the study area. All traffic-related inputs to the air

Table 5-1
Ambient Air Quality Summary
Redwood City And San Francisco Monitoring Stations

Pollutant	Average Time	California Air Quality Standards	Federal Primary Standards	Maximum Concentrations ppm (a)					Second Highest Concentrations ppm (a)					Number of Days Exceeding State Standard (b)				
				1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
Ozone (c)	1 hr	0.09 ppm	0.12 ppm	0.10	0.10	0.08	0.08	0.09	0.10	0.09	0.06	0.07	0.07	2	1	0	0	0
Carbon Monoxide	1 hr	20 ppm	35 ppm	13.0	13.0	12.0	11.0	12.0	10.0	13.0	12.0	10.0	11.0	0	0	0	0	0
	8 hrs	9.0 ppm	9 ppm	5.4	5.3	5.9	6.5	4.8	5.4	5.3	5.8	5.6	4.6	0	0	0	0	0
Nitrogen Dioxide	1 hr	0.25 ppm	None	0.13	0.12	0.12	0.12	0.10	0.12	0.11	0.12	0.11	0.10	0	0	0	0	0
	Annual	None	0.053 ppm	0.024	0.024	0.022	0.021	0.021	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sulfur Oxides measured as SO_2	1 hr	0.25 ppm	None	0.03	0.05	0.03	0.04	0.04	0.03	0.04	0.03	0.04	0.03	0	0	0	0	0
	24 hrs	0.04 ppm (e)	0.14 ppm	0.013	0.017	0.012	0.016	0.013	NR	NR	0.011	0.014	0.012	0	0	0	0	0
	Annual	None (f)	0.03 ppm	0.001	0.003	0.001	0.002	0.002	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Suspended Particulate Matter (PM_{10}) (d)	24 hrs	50 $\mu g/m^3$	150 $\mu g/m^3$	94	90	137	90	80	75	84	93	84	75	4	10	8	12	7
	Annual	30 $\mu g/m^3$	50 $\mu g/m^3$	34.7	33.3	28.2	32.1	24.9	NR	NR	NR	NR	NR	1	1	0	1	0

Source: Bay Area Air Quality Management District and California Air Resources Board, 1988, 1989, 1990, 1991, and 1992 (CARB 1988-1992). The ozone, carbon monoxide, nitrogen dioxide and particulate matter (PM_{10}) data are collected at the Redwood City station; the sulfur dioxide data are collected at the San Francisco station at 10 Arkansas Street.

Notes:

a) Maximum concentration units for ozone, carbon monoxide, nitrogen dioxide, and sulfur oxides are in parts per million (ppm). The concentration unit for suspended particulates (PM_{10}) is micrograms per cubic meter ($\mu g/m^3$).
b) For annual standards, a value of 1 indicates the standard has been exceeded.
c) California standard for ozone was 0.10 ppm for the year of 1988. The standard was changed to 0.09 ppm in 1989.
d) In July 1987, the federal standards for TSP were replaced by standards for fine particulate matter less than 10 microns in diameter (PM_{10}).
e) The California standard for SO_x changed from 0.05 ppm to 0.04 ppm on 1/1/93.
f) None = no standard in place.
g) NR = not reported.

Table 5-2
Background CO Concentrations

Year	CO Concentration (ppm)(1) 1989 Second High		Rollback Factor(2)	Concentration (ppm) Background CO	
	1-hour Average	8-hour Average		1-hour Average	8-hour Average
1993	13.0	5.3	0.80	10.4	4.2
1998	13.0	5.3	0.66	8.6	3.5
2000	13.0	5.3	0.61	7.9	3.2
2010	13.0	5.3	0.51	6.6	2.7

Sources:

1) CARB. 1989.
2) BAAQMD, 1993b.

quality analysis were developed by the project transportation consultant, Parsons Brinckerhoff Quade and Douglas (PBQ&D). For further detail, refer to the Transportation Technical Report.

5.4.1 Travel Demand Forecasting

The transportation impact analysis, and therefore the traffic data upon which the air quality analysis is based, is based on 1990 and 2010 travel demand forecasts obtained from the MTC. The MTC is the local Metropolitan Planning Organization (MPO) for the San Francisco Bay Area and the FTA requires the use of the MPO modeling procedure. The MTC forecast provided both transit travel (including BART travel) and highway travel for the study area.

A sub-area traffic model was developed and calibrated to assign projected highway travel to the local street network in the study area and to allocate the BART trips to the various stations in the corridor. The 1993 sub-area traffic model was calibrated based on A.M. and P.M. peak-hour traffic volumes measured during fall 1993 and spring 1994 specifically for this project.

Traffic volumes for the 1993 No Build Alternative are based on the actual measured traffic counts, supplemented by data from local jurisdiction. All other traffic volumes are modeled, or predicted. Growth factors, based on the most recent forecasts of current and future population, employment, and land use for the study area, were used to develop the 1998, 2000, and 2010 traffic forecasts. The Association of Bay Area Governments (ABAG) is the local agency responsible for providing the population and employment forecasts. Cumulative impacts associated with other known projects in the study area have been included in the travel model forecasts.

5.4.2 Definition of the Area Substantially Affected by the Project

The traffic study area has been identified by PBQ&D as the area substantially affected by the project. Within the study area, traffic impacts were analyzed in terms of both freeway operations and local intersection operations. The selection of intersections within the study area potentially affected by the project was based on available data from the local jurisdictions, results from the

previous AA/DEIS/DEIR, comments from local jurisdiction on the AA/DEIS/DEIR traffic analysis, and the professional judgement of the traffic consultant.

PBQ&D identified approximately 63 intersections within the study area for which traffic impacts were quantitatively examined. Traffic analysis of these 63 intersections as well as 32 new intersections resulting from the different BART build alternatives was performed for each of the alternatives listed in Table 5-3.

It was the professional judgment of PBQ&D that the set of 63 intersections includes all areas where significant adverse impacts could potentially occur, and includes the key intersections in all neighborhoods, commercial areas, and downtown areas. Therefore, these intersections represent the area substantially affected by the proposed BART extension.

5.5 Roadway Intersection Analysis Methodology

Localized CO impacts associated with the project alternatives are defined as changes in CO concentrations at roadway intersections or BART parking lots. Local CO concentrations could increase where traffic could be delayed or increased as a result of BART-associated vehicular traffic. At some roadway intersections, CO concentrations could decrease as a result of reductions in traffic volumes and/or congestion, producing beneficial impacts.

The methodology used for determining local CO impacts is consistent with the EPA conformity assessment procedures in 40 CFR 93.131 and with typical NEPA/CEQA air quality impact analyses. Curbside CO impacts at selected roadway intersections were estimated using EPA-recommended air quality models, in conjunction with traffic data specific to the alternative and analysis year. The details of each step in the analysis are described below. The methodology used to evaluate local CO impacts from BART station parking lots is described separately in Section 5.6.

5.5.1 Selection of Intersections for Analysis

PBQ&D quantitatively analyzed the traffic conditions at 95 existing and proposed intersections in the study area. At the suggestion of the MTC (1993c) and the BAAQMD (1993), Ogden selected 24 intersections for local carbon monoxide analysis. A three-step selection process was employed to ensure that the locations most impacted under each project alternative were included for analysis.

The first step consisted of the EPA-recommended procedure (EPA, 1992a) for ranking and selecting intersections for CO impacts modeling. That procedure is summarized as follows:

1) rank the top 20 signalized intersections by traffic volumes;

2) calculate the level of service (LOS) for the top 20 intersections based on traffic volumes;

3) rank these intersections by LOS;

4) model the top 3 intersections based on the worst LOS; and

5) model the top 3 intersections based on the highest traffic volumes.

Table 5-3
BART Alternatives Included in Traffic and Microscale CO Analyses

Proposed Project – Locally Preferred Alternative (LPA)
Alternative I – No Build Alternative
Alternative II – Transportation Systems Management (TSM)
Alternative III – BART to Airport Intermodal (Base Case)
Alternative IV – Airport Aerial East of Highway 101 (with I-380/San Bruno Station option)
Alternative V – Minimum Length Subway to Millbrae Intermodal (with I-380/San Bruno Station option)
Design Option V-B – Minimum Length Subway to San Bruno (with I-380/San Bruno Station option)
Alternative VI – Millbrae Avenue via the Airport International Terminal

The EPA selection procedure ensured that signalized intersections where impacts are likely to be worst were included in the analysis. Intersection rankings by 1998 A.M. and P.M. peak-hour traffic volumes are presented in Attachment C.

Second, all existing and proposed intersections were ranked by level of service in 1998, the planned year of opening for the project. All intersections, including non-signalized intersections, with a predicted level of service for the dominant traffic movement of D, E, or F under 1998 peak hour (A.M. or P.M.) traffic conditions were included in the analysis.

Third, due primarily to CEQA considerations, a number of other intersections were included that have the potential to change markedly under BART build alternatives, or that were identified as important to the local public during the environmental review process. These included intersections directly adjacent to new BART stations. Some of these intersections are not present under No Build conditions, but would be constructed along with the BART extension.

This three-step process was designed to select 1) those intersections where CO concentrations are expected to be highest and 2) those intersections expected to undergo the greatest change from existing conditions under BART build alternatives. The 21 roadway intersections selected with this process were analyzed for local CO impacts under the proposed project, Alternatives I, II, III, IV, and V, and Design Option V-B.

For Alternative VI, the three-step process resulted in the selection of three additional intersections for local CO analysis. These three additional intersections were analyzed under Alternatives I, II, and VI only. The original 21 intersections were analyzed with Alternative VI as well.

Table 5-4 identifies the 24 intersections selected for local CO impacts analysis. The selected intersections represent those most likely to have significant adverse impacts and those where impacts are expected to change significantly under BART alternatives versus the No Build Alternative.

Table 5-4 Roadway Intersections Selected for Microscale CO Analysis	
El Camino Real/Hickey Boulevard	El Camino Real/Sneath Lane
I-280 Southbound Ramps/Sneath Lane	Huntington Avenue/Sneath Lane
Mission Road/Evergreen Drive	El Camino Real/San Bruno Avenue
Mission Road/"new street"(1)	San Mateo Avenue/San Bruno Avenue
El Camino Real/"new street"(1)	2nd Avenue/San Bruno Avenue
Mission Road/Grand Avenue	San Mateo Avenue/Huntington Avenue
Chestnut Avenue/Grand Avenue	Huntington Avenue/Angus Avenue
Mission Road/Oak Avenue	El Camino Real/Center Street
El Camino Real/Arroyo Drive	El Camino Real/Millbrae Avenue
Junipero Serra Boulevard/Westborough Boulevard	Rollins Road/Millbrae Avenue(2)
El Camino Real/Westborough Boulevard	El Camino Real/Murchison Drive(2)
El Camino Real/So. Spruce Avenue	California Drive/Broadway(2)

Notes:

1) The "new street" does not currently exist; it would be built under the proposed project, Alternatives IV, V, and VI, and Design Option V-B.

2) These intersections were analyzed under Alternatives I, II, and VI only and would not be affected by the other BART build alternatives.

5.5.2 Dispersion Model Selection

Two air quality models were employed for quantitative analysis of local CO impacts: the California Line Source Dispersion Model (CALINE4) (Caltrans, 1989c) and CAL3QHC Version 2.0 (EPA, 1992). CALINE4 is the preferred model within California for analysis of local CO impacts, and was the "base," or default, model employed by Ogden in this analysis. CAL3QHC is the current EPA-recommended model for analysis of signalized intersections, and was employed at those intersections for which it was particularly suited. The model employed for the analysis of each specific intersection is indicated in Attachment D. Brief model descriptions and the criteria for model selection are presented below.

CALINE4

CALINE4 is based on the Gaussian diffusion equation and employs a mixing zone concept to characterize pollutant dispersion above the roadway. The model contains special options for modeling pollutant concentrations near intersections. A unique feature of CALINE4 is the internal calculation of modal emission factors. These modal factors attempt to account for the variation in vehicle emissions during the cruise, deceleration, idle, and acceleration modes of vehicle operation at an intersection. CALINE4 does not perform intersection capacity analysis internally; that analysis, including determination of vehicle queue lengths and idling times, must be performed by the user.

Generally, CALINE4 was employed for CO analysis at 1) all-way stop intersections, 2) "unsignalized" intersections (intersections with a stop sign on the minor road only), and 3) signalized intersections with a relatively low volume to capacity (V/C) ratio. However, limitations of CALINE4 regarding minimum link length and allowable number of links precluded the use of the model under the above conditions at certain intersections.

The CALINE4 intersection link option provides internal calculations of modal emission factors, accounting for the cruise, deceleration, idle, and acceleration modes of vehicle operation at the traffic intersection. However, the model requires that each intersection link be long enough to encompass the deceleration, idling, and acceleration zones of vehicle behavior; this requirement typically results in intersection links several hundred feet in length. For those intersections where the CALINE4 intersection link would extend into an adjacent intersection, or would deviate significantly from the roadway centerline due to roadway curvature, CAL3QHC (see below) was employed instead of CALINE4.

CALINE4 allows the specification of up to 20 links and up to 20 receptors. At some intersections, geometric complexities such as a large number of traffic lanes, skewed alignment (e.g., a "Y"), severe road curvature, and/or other adjacent intersections required the use of more than 20 links. Because CAL3QHC allows the use of up to 120 links, it was employed instead of CALINE4 when intersection geometry required the use of more than 20 links.

CAL3QHC

CAL3QHC Version 2.0 is the current EPA-recommended model for predicting CO concentrations in the vicinity of traffic intersections (EPA, 1992a). This model combines the dispersion component of CALINE3 (the predecessor of CALINE4) with a traffic algorithm for estimating vehicle queue lengths. The CAL3QHC traffic algorithm employs a hybrid approach towards queuing analysis, utilizing a simplified *1985 Highway Capacity Manual* (HCM) (FTA, 1985) procedure for under-saturated conditions (volume to capacity ratio (V/C) less than one) and a deterministic queuing procedure for over-saturated conditions (V/C>1). Because CAL3QHC was specifically designed to model near- and over-capacity intersection conditions, it was employed at those signalized intersections with volume to capacity ratios close to or greater than one. Additionally, CAL3QHC was employed in those instances where intersection geometry dictated the use of more than 20 links.

5.5.3 Vehicular Emission Rates

The procedures to establish CO emission rates, used as input to the microscale CO dispersion modeling analysis, are described below. EPA conformity regulations at 40 CFR 93.111 require the use of the "latest emission estimation model available" for conformity analysis. The MTC Resolution No. 2270 and the most recent MTC draft conformity guidance have similar requirements. In this analysis, the most recent version of the California EMFAC7 vehicular emissions model was used to obtain CO emission factors (g/mi) for each forecasting year. A discussion of the emission rate calculation procedure is presented first, followed by a discussion of the selected project-specific input variables.

Composite CO emission factors were calculated with the compositing program ENV028F (Caltrans, 1993) from EMFAC7F Version 1.0 (CARB, 1993a) impact rates. At the time of this analysis, EMFAC7F 1.0 was the most recent EPA-approved model for predicting vehicular emissions. EMFAC7F calculates CO impact rates (grams CO emitted per vehicle-hour) over a range of temperatures and vehicle speeds for 13 vehicle categories, eight vehicle emissions processes, summer and winter fuel blends, and for "yes" and "no" Inspection and Maintenance (I/M) Program designations.

The compositing program ENV028F is a Caltrans addition to EMFAC7F, consisting of a "front end" user input module and a "back end" composite emission factor calculation routine. ENV028F produces composite CO emission factors over a range of temperatures and vehicle speeds for a user-specified vehicle mix, calendar year, season, and I/M designation. Total CO emission factors are calculated as the sum of three emissions processes: running (hot stabilized) emissions, and either cold or hot start incremental emissions, if applicable. Composite CO emission factors used in this analysis are presented in Table 5-5.

For a given calendar year, season, temperature, and I/M designation, the CO emission factor for a particular vehicle category and speed is calculated by ENV028F from:

$$EF_{i,\,SPD} = \frac{R_{SPD}}{SPD} + f_C \frac{C}{SPD \times d_t} + f_H \frac{H}{SPD \times d_t} \qquad (5\text{-}1)$$

where:

$EF_{i,\,SPD}$	=	CO emission factor (g/mi) for vehicle category *i* at speed SPD;
R_{SPD}	=	Running emissions (g/hr) at speed SPD;
SPD	=	Vehicle speed (mi/hr);
f_C	=	Fraction of vehicles in cold start transient mode (unitless);
C	=	Cold start incremental emissions (g/trip);
d_t	=	Duration of transient mode trip (hr/trip)
	=	0.14 hr/trip (505 s/trip) as defined by the Federal Test Procedure (40 CFR Part 86, Appendix I);
f_H	=	Fraction of vehicles in hot start transient mode (unitless); and
H	=	Hot start incremental emissions (g/trip).

The variables R_{SPD}, C, and H in Equation 5-1 are the hot stabilized, cold start, and hot start impact rates, respectively, produced by EMFAC7F. The variables f_C, f_H, and SPD are the user-defined cold start fraction, hot start fraction, and vehicle speed. The duration of the transient mode trip, d_t, is defined by the Federal Test Procedure (FTP). Equation 5-1 is employed to calculate emission factors for each of 13 vehicle categories. The emission factors are then weighted by user-supplied vehicle mix percentages to produce a single composite emission factor with units of grams per mile.

Note that Equation 5-1 assumes that cold and hot start incremental emissions are uniformly distributed over the duration of the transient mode trip (505 seconds as defined by the FTP). This is not the case; transient emissions are very high immediately after vehicle startup, and gradually decrease to zero as the engine achieves a stable operating temperature (Caltrans, 1989). This effect is illustrated in Figure 5-1 (a) and (b). Since approximately 55 percent of the incremental emissions are released in the first 120 seconds of the transient cycle (Figure 5-1 (c)), Equation 5-1 overpredicts the emission rate of all vehicles that have been running for more than two minutes. In urban corridors, where vehicles are drawn from a larger area of potential trip origins, more vehicles tend to be in the latter stages of the transient start mode. Therefore, the assumption (made in this analysis) of uniform distribution of excess emissions over the duration of the transient startup mode is a conservative one.

Table 5-5
Composite CO Emission Factors (g/mi)

Speed (mph)	Calendar Year 1993	1998	2000	2010	Speed (mph)	Calendar Year 1993	1998	2000	2010
Idle	6.03	4.05	3.32	1.36	24	17.79	11.68	9.68	4.41
3	120.67	80.90	66.41	27.19	25	17.13	11.24	9.32	4.25
4	94.93	63.13	51.97	21.93	26	16.52	10.86	9.00	4.09
5	78.15	51.78	42.72	18.43	27	15.96	10.46	8.67	3.95
6	66.27	43.84	36.23	15.89	28	15.43	10.11	8.38	3.83
7	57.42	37.96	31.43	13.96	29	14.94	9.78	8.11	3.71
8	50.59	33.45	27.72	12.43	30	14.48	9.48	7.86	3.59
9	45.18	29.88	24.78	11.19	31	14.04	9.19	7.62	3.49
10	40.79	26.99	22.39	10.16	32	13.63	8.92	7.40	3.39
11	37.19	24.60	20.42	9.30	33	13.24	8.66	7.19	3.30
12	34.17	22.61	18.77	8.57	34	12.87	8.42	6.99	3.22
13	31.62	20.92	17.37	7.94	35	12.53	8.20	6.81	3.14
14	29.44	19.47	16.17	7.40	36	12.21	7.99	6.64	3.07
15	27.56	18.21	15.12	6.92	37	11.90	7.79	6.47	3.01
16	25.91	17.12	14.21	6.50	38	11.62	7.60	6.32	2.95
16	25.62	16.93	14.05	6.43	39	11.35	7.43	6.18	2.89
17	24.47	16.15	13.41	6.13	40	11.11	7.27	6.05	2.84
18	23.19	15.30	12.70	5.81	41	10.88	7.12	5.93	2.80
19	22.05	14.54	12.06	5.51	42	10.67	6.98	5.81	2.76
20	21.03	13.85	11.49	5.25	43	10.49	6.85	5.71	2.72
21	20.10	13.23	10.97	5.01	44	10.32	6.74	5.62	2.69
22	19.26	12.66	10.50	4.79	45	10.17	6.64	5.54	2.67
23	18.49	12.15	10.07	4.59					

Notes:

1) Composite emission factors calculated by ENV028F (CalTrans, 1993) from EMFAC7F Version 1.0 impact rates (CARB, 1993a).

2) Idle emission factors (g/min) calculated by adjusting 3-mph emission factors (g/mi) to time-rate.

3) 16.2-mph emission factors calculated by linear interpolation between 16- and 17-mph values.

4) Assumptions:
temperature = 45°F (CalTrans, 1989a);
winter season;
I/M Program in effect;
% Cold/Hot starts = 20.6/27.3 (BAAQMD); and
vehicle mix from San Mateo County Ozone Planning Inventory reports (CARB, 1993c).

User-specified inputs and EMFAC7F and ENV028F include calendar year, ambient temperature, vehicle speed, season, Inspection and Maintenance (I/M) Program designation, vehicle category mix, and vehicle operating mode mix. The values specified for ENV028F/EMFAC7F input variables and the rationale for their use are provided below.

Calendar Year. Composite CO emission factors were generated for each calendar year analyzed in the DEIR/SDEIS: 1993, 1998, 2000, and 2010.

Temperature. Vehicular CO emissions vary inversely with ambient temperature. Carbon monoxide is a product of incomplete (inefficient) combustion, and, within the ambient temperature range, combustion efficiency decreases with decreasing temperature.

The temperature at which CO emission rates were calculated for this analysis was selected for consistency with the meteorology inputs specified to the CALINE4 and CAL3QHC dispersion models. The temperature selection procedure, described below, is recommended by Caltrans (1989a) for worst-case 1-hour microscale CO analysis. In other words, the temperature represents a project-specific worst-case temperature for 1-hour CO analysis.

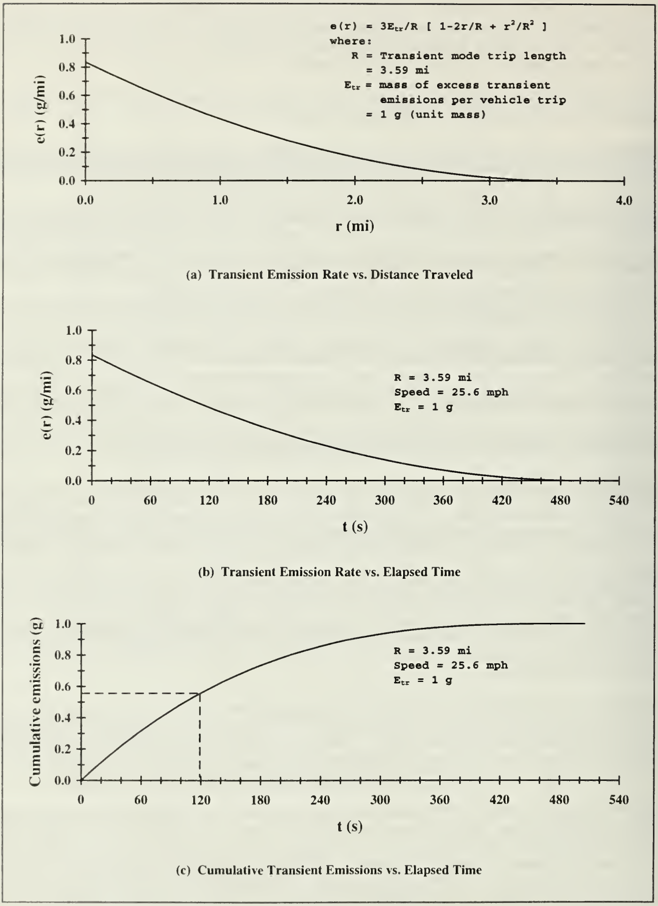
All composite CO emission factors were generated for the user-specified temperature of 45°F. This temperature was calculated by adding an appropriate adjustment factor to the lowest January mean minimum temperature over a representative three-year period. Forty-five degrees Fahrenheit is the sum of the lowest January mean minimum temperature measured at San Francisco International Airport (SFIA) over the three-year period from 1984 to 1986, 40°F (Caltrans 1989a), and the morning (06:00-10:00) and evening (17:00-21:00) temperature adjustment factor of +5°F (Caltrans 1989a). The SFIA temperature data were deemed appropriate for project-specific use, as the station lies within the project study area.

Vehicle Speeds. Composite CO emission factors were generated over the range of possible vehicle speeds, in 1-mph increments. Emission factors at non-whole number vehicle speeds (e.g., 16.2 mi/hr as required for CALINE4 intersection links) were manually calculated by Ogden using linear interpolation between the adjacent whole number emission factors. Idle emission factors (g/min) were calculated internally by ENV028F by converting the 3-mph emission factors (g/mi) to time-rate.

Season. EMFAC7F generates impact rates for wintertime and summertime fuel blends; winter impact rates reflect the implementation of Phase 1 (oxygenated fuels) regulations, whereas summer impact rates do not. All composite CO emission factors were generated for the winter season. Selection of the winter season was consistent with the assumption of worst case January meteorological conditions.

Inspection and Maintenance (I/M) Program Designation. EMFAC7F generates I/M and non-I/M impact rates; the I/M rates are for areas of California that have implemented the State Inspection and Maintenance ("smog check") Program, while the non-I/M rates apply to areas without the I/M program. Because the California I/M program is in effect in the project study area, all composite CO emission factors were generated with the "yes" I/M designation.

Vehicle Categories. EMFAC7F generates impact rates for eight vehicle classes (light duty autos, light duty trucks, medium duty trucks, heavy duty trucks, urban diesel buses, and motorcycles) and three technology groups (non-catalyst-equipped, catalyst-equipped, and diesel) for a total of 13 distinct vehicle categories. ENV028F requires user input of the on-road percentage for each of the eight vehicle classes; ENV028F then internally subdivides the user-supplied percentages into the different technology groups to obtain percentages for each of the 13 categories.



(a) Transient Emission Rate vs. Distance Traveled

(b) Transient Emission Rate vs. Elapsed Time

(c) Cumulative Transient Emissions vs. Elapsed Time

Figure 5-1 Distribution of Transient Starting Emissions (Caltrans, 1989b)

The total daily vehicle miles traveled (VMT) by each vehicle class was obtained from calendar year-specific San Mateo County Ozone Planning Inventory reports (CARB, 1993c). The San Mateo County daily VMT data are summarized in Table 5-6. The county-specific on-road vehicle category mix, based on the daily VMT data in Table 5-6, was assumed in the calculation of composite CO emission factors at all individual roadway intersections considered in the analysis, as recommended by CARB (1993d).

Vehicle Emission Processes. EMFAC7F generates impact rates for eight distinct vehicle emission processes: crankcase blowby emissions, diurnal evaporative emissions, hot soak evaporative emissions, resting loss evaporative emissions, cold start incremental emissions, hot start incremental emissions, incremental emissions, and running emissions. Composite emission factors calculated for this local CO impacts analysis incorporate only cold and hot start incremental emissions and running (hot stabilized) emissions; the remaining emissions processes do not produce CO. The relevant emissions processes are defined below.

Vehicle Operating Modes. Vehicular CO emissions are greatly affected by the operating mode, or thermal operating state, of the vehicle. For purposes of composite emission factor calculation, vehicles are assigned to one of three thermal operating states: hot stabilized (warmed up), cold start transient, or hot start transient. CO emissions from vehicles in the cold and hot start transient modes are much greater than those from hot stabilized vehicles. Total CO emissions from a vehicle in transient mode are the sum of emissions associated with the hot stabilized operation of the vehicle and the additional transient emissions that occur before the vehicle completely warms up. The transient mode is defined by the FTP as the first 505 seconds following ignition, after which the vehicle is defined to be in hot stabilized mode. A start is defined as cold if the vehicle has been off for more than one hour if catalyst-equipped, or more than four hours if not catalyst-equipped, following hot stabilized operation. A vehicle start that occurs within one or four hours, as appropriate, following hot stabilized operation is defined as hot.

The EPA (1992a) recommends the use of localized cold start and hot start percentages in areas where the local air agency has measured and compiled them. The EPA also recommends, "for areas that lack localized data, the use of the FTP conditions (20.6 percent cold start, 27.3 percent hot start) may be used as input." In conversations with the BAAQMD (1994) and with the FTA (1993b) regarding this project, no local data were found to be available. Both agencies therefore recommended use of the FTP values for this analysis. The lack of local operating mode data was confirmed independently by Korve Engineering (1994c) via a local literature search and discussions with project proponents for other recent local projects.

Based on the above discussion, the percentage of vehicles in cold start transient mode was assumed to be 20.6 percent, and the percentage in hot start transient mode assumed to be 27.3 percent.

5.5.4 Meteorological Inputs

Meteorological conditions must be specified as input to the microscale CO dispersion models. At this time, neither CALINE4 nor CAL3QHC allows the use of actual sequential hourly meteorological data, but rather accept user-specified values for temperature, wind speed, wind direction, stability class, sigma theta (the latter being a measure of the fluctuation in wind direction within a given hour), and mixing height. Meteorological parameters for use in this analysis were selected based on EPA guidance (EPA 1992a), and reflect EPA default conditions appropriate for predicting worst-case 1-hour impacts. The values assigned to these meteorological parameters are presented in Table 5-7.

Table 5-6
Daily Vehicle Miles Traveled (VMT) by Vehicle Category
San Mateo County

Vehicle Category	Daily VMT							
	1993		1998		2000		2010	
Technology Group	(x1000 mi)	(% of TOTAL)	(x1000 mi)	(% of TOTAL)	(x1000 mi)	(% of TOTAL)	(x1000 mi)	(% of TOTAL)
Light Duty Autos								
Non-Catalyst	556		244		165		3	
Catalyst	13,125		13,871		14,050		14,333	
Diesel	173		58		37		6	
Total	13,854	76.1	14,173	75.5	14,252	75.3	14,342	74.4
Light Duty Trucks								
Non-Catalyst	73		19		5		0	
Catalyst	2,597		2,831		2,889		3,028	
Diesel	46		15		9		1	
Total	2,716	14.9	2,865	15.3	2,903	15.3	3,029	15.7
Medium Duty Trucks								
Non-Catalyst	45		18		10		0	
Catalyst	845		910		927		963	
Total	890	4.9	928	4.9	937	5.0	963	5.0
Heavy Duty Trucks								
Non-Catalyst	143		86		74		50	
Catalyst	201		284		306		384	
Diesel	286		309		318		365	
Total	630	3.5	679	3.6	698	3.7	799	4.1
Urban Bus								
Diesel	21	0.1	21	0.1	22	0.1	22	0.1
Motorcycles								
Non-Catalyst	101	0.6	108	0.6	110	0.6	121	0.6
TOTAL	18,212	100.0	18,774	100.0	18,922	100.0	19,276	100.0

Source: San Mateo County Ozone Planning Inventory Reports (CARB, 1993).

Table 5-7
Meteorological Values Used in Microscale CO Analysis

Meteorological Parameter	Value
Temperature	45°F
Wind Speed	1.0 m/s
Wind Direction	worst-case
Sigma Theta	25°
Stability Class	D
Mixing Height	1000 m

Temperature. The EPA does not provide a default temperature for use as model input, but rather provides guidance on selection of the site-specific temperature value. The value used in the dispersion modeling is consistent with that used in calculating the CO emission factors, and is a more conservative (lower) value than that derived using the EPA recommendations. The EPA recommends using the average January temperature; the air quality analysis uses the mean minimum January temperature based on three years worth of observations.

Wind Speed. The wind speed was set equal to 1.0 m/s for all model runs. This value was recommended by the BAAQMD, and is near the lowest recommended wind speed for use in CALINE4 of 0.5 m/s (Caltrans, 1989a).

Wind Direction. The specification of wind direction varies slightly between the two microscale models, but in both cases user input was designed to obtain worst-case results. CALINE4 allows the user to input a wind direction or, alternatively, performs a worst-angle wind search. The worst-angle wind search option was activated for all CALINE4 runs. In the CAL3QHC analyses, CO concentrations were calculated at wind angles in 15-degree increments (a total of 24 wind directions); the highest predicted concentration at any wind angle was accepted as the result.

Sigma Theta. Sigma theta (σ_θ) is the standard deviation of the wind direction. Horizontal dispersion increases with increasing σ_θ. A value of 25 degrees was assigned to σ_θ; this value was recommended by the Bay Area Air Quality Management District.

Stability Class. The Pasquill Stability Classification consists of six classes: A, the most unstable (greatest amount of turbulent diffusion), through F, the most stable (least amount of turbulent diffusion). CALINE4 modifies these classes to include vehicle-induced thermal effects, and recognizes seven stability classes, A through G. The EPA recommends use of stability class D for urban areas, based on the land use classification scheme of Auer. The Auer classification approach examines the land use within a three-mile radius of the "source," which in this case would be each intersection of interest, and assigns either an "urban" or "rural" classification to each type of land use. For example, open park land or fields are designated rural, while multifamily housing or dense single family housing are designated urban. If more than 50 percent of the land use within the three-mile radius is urban, then the overall classification is urban. The urban classification is appropriate for the study area, and thus D stability was specified for all model runs based on EPA guidance.

Mixing Height. Both microscale CO models are relatively insensitive to mixing height, although a common mixing height algorithm is built into the models which is designed to model nocturnal inversions. That algorithm is activated when a mixing height of less than 1000 m is entered. Since the peak hourly traffic period (and thus the peak CO impacts) do not occur at night, but rather during the A.M. or P.M. commute periods, the mixing height was set at 1000 m to bypass the algorithm.

The use of default meteorological data is supported by review of hourly 1990 and 1991 meteorological observations from San Francisco International Airport. Review of actual hourly meteorological data indicates that D stability predominates, occurring approximately 60 percent of the time. Wind speeds are almost never (less than 1% of the time) as low as 1 m/s at D stability, and are typically (over 40 percent of the time) higher than 2 m/s. Therefore, the EPA default assumptions appear to represent a reasonable worst case for this analysis for the peak hour. Over an 8-hour period, the use of worst-case defaults is even more conservative, specifically because persistent, low winds speeds are not a common occurrence, and, moreover, the dispersion algorithm assumes that the wind direction is also persistent (blowing directly at the receptor location from the source) over the 8-hour averaging period.

5.5.5 Intersection Geometry

Intersection plan views were obtained from a variety of sources. In some instances, recent construction drawings (e.g., roadway improvement plans) were available from the relevant city planning or engineering office (City of Millbrae, 1993; City of San Bruno, 1993). If acceptable plans were not available, then recent aerial photographs were obtained (Pacific Aerial Surveys, 1993).

Typically, the length of each CALINE4 intersection link was set to just encompass the deceleration, idling, and acceleration zones of vehicle behavior at the intersection; the roadway beyond the area of modal vehicle operation was modeled with non-intersection links. Each intersection leg was typically modeled to a distance between 500 and 1000 feet from the intersection itself, regardless of model used. Sensitivity analyses indicated that links located more than 500 feet from the intersection had negligible contributions to CO concentrations at the intersection (see Section 5.5.7 for receptor locations).

In most cases, each individual traffic lane at the intersection was modeled with a CALINE4 intersection link (or a CAL3QHC queue link). This one-link-per-lane method resulted in more accurate representation of the magnitude and location of vehicular emissions at the intersection than the use of only one intersection link per direction of travel with assignment of the worst-lane queuing data. At less traveled intersections, each traffic movement (i.e., left, straight, and right) was modeled with an intersection link (or queue link). Typically, one non-intersection link (or free flow link) per direction of travel was specified beyond the area of modal vehicle operation.

Geometry-related CALINE4 link inputs consist of link endpoint coordinates, roadway height above the surrounding ground, roadway mixing width, and stop line distance (intersection links only). Endpoint coordinates were scaled from an appropriate intersection plan view, using a local coordinate system. Roadway mixing width was calculated as the width of the traveled way (i.e., the width of the lanes represented by the link) plus 20 feet (Caltrans, 1989a). Stop line distance, the distance from the link endpoint to the stop line, was scaled from the intersection plan view.

Geometry-related CAL3QHC link inputs are similar to those required for CALINE4. Link endpoint coordinates, roadway height, and mixing width were specified for all links in the same manner as described above for CALINE4.

5.5.6 Traffic-Related Inputs by Intersection Type

The estimation of CO impacts via dispersion modeling requires user input describing vehicular volume, movement, and delay. This section describes the CALINE4 and CAL3QHC intersection-specific model inputs that specify the traffic conditions at a given intersection. These conditions are different at the same intersection between alternatives, and for each forecasting year for each alternative. For each intersection analyzed, the basic traffic data for each alternative and each forecasting year was provided by the transportation consultant, PBQ&D, in the form of hard copy output from their local traffic model network. Traffic input parameters that were not provided directly by PBQ&D were developed using procedures and guidance from the standard references for these types of analysis, and/or in consultation with the project traffic engineers. Those references include the *Highway Capacity Manual* (FTA, 1985 and 1993a), *CALINE4 – A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways* (Caltrans, 1989b), *Air Quality Technical Analysis Notes* (Caltrans, 1992a), and *User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections* (EPA, 1992b).

Three types of intersections were included in the intersections analyzed: signalized intersections, where the traffic is controlled by signal light(s); "unsignalized" intersections, where traffic on the minor road is controlled by stop sign(s) and traffic on the major road has no signal light or stop sign control; and all-way stop intersections, where traffic in all directions is controlled by stop signs. Intersection type is identified in Attachment D for each intersection analyzed, under each alternative. Note that in some cases, the intersection type varies from alternative to alternative; e.g., Huntington Avenue/Sneath Lane is an all-way stop intersection under the No Build Alternative but is signalized under the proposed project.

Although CALINE4 and CAL3QHC contain essentially the same dispersion algorithm, the traffic components of the two models, which specify the vehicular CO emissions to the dispersion algorithm, are quite different. The procedures followed in this analysis to develop the required input parameters are described below for each type of intersection, for each model separately.

The procedures followed for calculation of the traffic-related inputs to each model are described below for each of three intersection types.

Signalized Intersections - CALINE4 Inputs

Signalized intersection traffic data were provided by PBQ&D (1994a). These data consisted of:

- intersection lane configuration;
- lane-by-lane traffic volumes;
- signal phasing;
- critical traffic volumes; and
- LOS designation.

There are six types of CALINE4 links: at-grade, depressed, fill, bridge, parking lot, and intersection. In regards to the inputs required, however, there are essentially two types: non-intersection links and intersection links. The traffic-related input variables associated with each of these link types are discussed below.

Non-intersection Links. A CALINE4 non-intersection link represents a straight segment of roadway with constant width, height, traffic volume, vehicle speed, and vehicle emission factor. The traffic-related inputs required for non-intersection links are traffic volume (veh/hr) and emission factor (g/veh-mi). The segment running speed is both a direct model input and a data requirement for calculating the composite emission factor.

Traffic volumes were determined from PBQ&D intersection analysis worksheets (PBQ&D, 1994a). If multiple non-intersection links were employed to model traffic traveling in the same direction, then the total traffic volume was evenly distributed over those links.

Non-intersection link emission factors were calculated with the compositing program ENV028F from EMFAC7F impact rates (see Section 5.5.3). For a given link, the emission factor was calculated at the segment running speed as determined using methodology presented in the 1985 HCM, as follows:

1) posted speed limit was obtained from PBQ&D;

2) arterial classification (Type I, II, or III) was determined from Tables 11-2 and 11-3 of the 1985 HCM;

3) free flow speed was taken as the lower of the posted speed limit and the default free flow given in Table 11-4 of the 1985 HCM;

4) segment length, i.e., distance from intersection to nearest signal control (stop sign or traffic signal), was scaled from an appropriate aerial photo or street map;

5) running time (s/mi) on segment was determined from Table 11-4 of the 1985 HCM as a function of arterial classification, free flow speed, and segment length; and

6) segment running speed (mi/hr) was calculated from segment running time by simple unit conversion.

Intersection Links. A CALINE4 intersection link represents a straight segment of roadway encompassing the cruise, deceleration, idle, and acceleration modes of vehicle operation at the traffic intersection. Traffic-related input variables required for CALINE4 intersection links are:

- cruise speed (mi/hr);
- deceleration and acceleration times (s);
- approach and depart volumes (veh/hr);
- composite idle emission rate (g/veh/min);
- composite emission factor at 16.2 mi/hr (g/veh/mi);
- number of vehicles handled per cycle (veh);

- number of vehicles delayed per cycle (veh); and
- maximum and minimum vehicle idle times (s).

Cruise speed for a given intersection link was taken as the average of the appropriate two segment running speeds, as calculated using the 1985 HCM procedure described above. For example, the cruise speed for an intersection link with north-south alignment was set equal to the average of the segment running speeds calculated for the northern and southern intersection legs.

Deceleration time is the time required for vehicles to decelerate from cruise speed to a full stop. In reality, this value is dependent on a variety of factors, such as cruise speed, vehicle characteristics (weight, braking ability), roadway grade, and pavement conditions. For the purposes of this analysis, deceleration time was varied only according to cruise speed. The values of deceleration time corresponding to different cruise speeds are shown in Table 5-8. These values were derived from AASHTO speed vs. distance plots for comfortable deceleration of passenger cars on level grade, assuming a constant rate of deceleration during the event (AASHTO, 1990).

Acceleration time is the time required for vehicles to accelerate from rest to the cruise speed. An acceleration rate of 2.2 mi/hr/s was assumed at all intersections. This value is recommended by Caltrans for most urban and suburban intersections (Benson, 1991). Acceleration times were then calculated from:

$$ACCT = \frac{SPD}{a} \tag{5-2}$$

where:

ACCT = acceleration time (s);
SPD = cruise speed (mi/hr); and
a = acceleration rate (mi/hr/s).

Equation 5-2 assumes a constant rate of acceleration during the event. Although this does not typically occur, the assumption of constant acceleration is consistent with the CALINE4 modal emission factor algorithm and is recommended by the author (Benson, 1991).

Approach and depart traffic volumes were determined by PBQ&D (1994a). By requiring the specification of both approach and depart volumes for each intersection link, CALINE4 implicitly accounts for vehicle turning movements at the intersection. Approach and depart volumes are assigned to the intersection link relative to the stop line location.

CALINE4 requires input of composite CO emission factors at 16.2 mi/hr and at idle. Emission factors were calculated with the compositing program ENV028F from EMFAC7F impact rates, as described in Section 5.5.3. Composite emission factors at 16.2 mi/hr, used in the internal calculation of modal emission factors, were manually calculated by Ogden using linear interpolation between the 16- and 17-mph factors produced by ENV028F. Idle emission factors (g/min) were calculated internally by ENV028F by converting the 3-mph emission factors (g/mi) to time-rate. The remaining CALINE4 intersection link input parameters describe the queuing, or vehicle delay, conditions at the intersection: maximum and minimum vehicle idle times, number of vehicles handled per cycle, and number of vehicles delayed per cycle. These conditions are extremely important for local air quality impact analysis, as CO emissions (g/veh/mi) are very high for slow-moving or stopped vehicles.

Table 5-8
Deceleration Times

Initial Speed (mi/hr)[1]	Distance (ft)[2]	Deceleration Rate (ft/s^2)[3]	Deceleration Time (s)[4]
20	80	5.38	5.5
25	130	5.17	7.1
30	175	5.53	8.0
35	220	5.99	8.6
40	265	6.49	9.0
45	310	7.03	9.4
50	360	7.47	9.8

Notes:

1) Cruise speed
2) Distance required for vehicle to decelerate to a complete stop. From Figure II-17 of AASHTO (1990).
3) Assumes constant rate of deceleration.
4) Time required for vehicle to decelerate from cruise speed to a complete stop. Assumes constant rate of deceleration.

Although not a direct CALINE4 input, total signal cycle duration was necessary for calculation of the required CALINE4 queuing inputs. Field measurement of total signal cycle duration was conducted by BayMetrics Traffic Resources (BayMetrics, 1993). These values were used for all analyses of those intersections with no appreciable geometry changes from the existing conditions. In those circumstances where cycle duration would likely change from existing conditions as a result of, for example, addition of a fourth intersection leg, conversion from an all-way stop to a traffic signal, or construction of an entirely new intersection, total cycle duration was recommended by PBQ&D.

Maximum and minimum vehicle idle times represent the completely stopped, or idling, times of the first and last vehicles in the queue, respectively. Maximum vehicle idle time was set equal to the red time duration corresponding to that particular traffic movement. In other words, the first vehicle in the queue was assumed to stop just as the light turned red. Minimum vehicle idle time was always set equal to zero. In other words, the last vehicle in the queue was assumed to stop only momentarily before starting forward again.

Red time duration of each phase was calculated by Ogden, assuming that the fraction of the total effective green time allotted to each phase was equal to the fraction of the total critical volume associated with that phase:

$$\frac{d_i*}{D*}=\frac{v_i}{V} \tag{5-3}$$

where:

d_i* = effective green time of phase i (s);
$D*$ = effective green time of cycle (s);
v_i = critical volume of phase i (veh/hr); and
V = sum of critical volumes (veh/hr).

The appropriateness of this assumption was confirmed by the project transportation consultant (PBQ&D, 1994d).

The effective green time of phase i, d_i*, is given by:

$$d_i* = d_i - N(YFAC + K1) \tag{5-4}$$

where:

d_i = duration of phase i (green and yellow);
N = number of phases in signal cycle (unitless);
$YFAC$ = clearance interval lost time, or portion of yellow phase not used by motorists (s); and
$K1$ = startup delay (s).

The startup delay of the first vehicle in the queue, K1, was assumed to be 2.0 seconds. This value is specifically recommended for use in CALINE4 analyses (Benson, 1991).

The total effective green time for the entire cycle, D*, is given by:

$$D* = D - N(YFAC + K1) \tag{5-5}$$

where:

D = duration of signal cycle (s).

Substituting Equations 5-4 and 5-5 into Equation 5-3 and solving for d_i yields:

$$d_i = [D - N(YFAC + K1)]\frac{v_i}{V} + (YFAC + K1) \tag{5-6}$$

The nominal duration of each signal phase was calculated with Equation 5-6. The maximum vehicle idle time for phase i was calculated as the sum of the red time duration of all other phases (denoted by j):

$$IDT1_i = D - \sum_{j \neq i} d_j \tag{5-7}$$

where:

$IDT1_i$ = maximum vehicle idle time for phase i.

The number of vehicles handled per cycle was calculated by multiplying the vehicle arrival rate by the total signal cycle duration:

$$NCYC = \frac{VPHL \times D}{3600} \tag{5-8}$$

where:

NCYC = number of vehicles handled per cycle (veh);
VPHL = approach volume (veh/hr); and
3600 = conversion factor (s/hr).

The number of vehicles delayed per cycle was calculated in two steps. A first approximation was made by multiplying the vehicle arrival rate by the red time duration:

$$NDLA' = \frac{VPHL \times \sum_{j \neq i} d_j}{3600} \tag{5-9}$$

where:

NDLA' = first approximation of the number of vehicles delayed per cycle (veh); and
3600 = conversion factor (s/hr).

The number of vehicles stopped during the red phase, NDLA', was augmented by the additional vehicles delayed by the queue after the light turns green. Assuming a 2-second startup delay per queued vehicle and an additional 2-second startup delay for the first vehicle (Benson, 1991), the revised number of vehicles delayed per cycle, NDLA, was calculated from:

$$NDLA = \frac{VPHL \times \left(2 + 2 \times NDLA' + \sum_{j \neq i} d_j\right)}{3600} \tag{5-10}$$

where:

NDLA = number of vehicles delayed per cycle (veh); and
3600 = conversion factor (s/hr).

Signalized Intersections - CAL3QHC Inputs

Traffic input variables required for CAL3QHC are rather different than those required for CALINE4. Procedures for determination of the traffic inputs for CAL3QHC free flow and queue links are described below.

Free Flow Links. A CAL3QHC free flow link represents a straight segment of roadway having constant width, height, traffic volume, vehicle speed, and vehicle emission factor (EPA, 1992b). Traffic inputs for free flow links consist of traffic volume (veh/hr) and emission factor (g/veh-mi).

Traffic volume for free flow links in the immediate vicinity of the intersection were determined from the lane volumes provided by PBQ&D (1994a). Traffic volumes at greater distances from the intersection (typically at least several hundred feet away) were evenly distributed over the free flow links representing that portion of the roadway. In other words, if parallel free flow links were used to model traffic in the same direction of travel, then the total traffic volume was evenly distributed over those links.

Free flow link emission factors were calculated with the compositing program ENV028F from EMFAC7F impact rates, as described in Section 5.5.3. For a given link, the emission factor was calculated at the free flow link speed, defined as "the speed of a vehicle traveling along the link in the absence of the delay caused by traffic signals" (EPA, 1992b). The free flow link speed was calculated for each intersection leg using methodology presented in the 1985 HCM, as follows:

1) posted speed limit was obtained from PBQ&D;

2) arterial classification (Type I, II, or III) was determined from Tables 11-2 and 11-3 of the 1985 HCM;

3) free flow speed was taken as the lower of the posted speed limit and the default free flow given in Table 11-4 of the 1985 HCM;

4) segment length, i.e., distance from intersection to nearcst signal control (stop sign or traffic signal), was scaled from an appropriate aerial photo or street map;

5) running time (s/mi) on segment was determined from Table 11-4 of the 1985 HCM as a function of arterial classification, free flow speed, and segment length; and

6) free flow link speed (mi/hr) was calculated from segment running time by simple unit conversion.

The above method ensures that the free flow link speed for which the composite CO emission factor was determined was lower (more conservative) than both the posted speed limit and the default free flow link speed given in Table 11-4 of the 1985 HCM.

Queue Links. A CAL3QHC queue link represents a straight segment of roadway with constant width and emission source strength, on which vehicles are idling for a specified period of time (EPA, 1992a). The queue link traffic inputs are:

- traffic volume (veh/hr);
- idle emission factor (g/veh/hr);
- total signal cycle duration (s);
- red time duration (s);
- clearance interval lost time (s);
- saturation flow rate (veh/hr/lane);
- signal type; and
- vehicle arrival type.

Traffic volume for queue links were determined from lane volumes as provided by PBQ&D (1994a).

Queue link idle emission factors were calculated with the compositing program ENV028F from EMFAC7F impact rates, as described in Section 5.5.3. Idle emission factors (g/veh/hr) were calculated internally by ENV028F by converting the 3-mph emission factors (g/veh/mi) to time-rate.

The procedures for determination of total signal cycle duration and red time duration for CAL3QHC queue links were the same as those described above for CALINE4 intersection links.

Clearance interval lost time is the portion of each yellow phase not used by motorists. A value of zero was assigned to clearance interval lost time for all queue links; the entire yellow time was assumed to be used by drivers.

Saturation flow rate is the theoretical capacity of a single lane, if there was no delay caused by the traffic signal. Saturation flow rate values of 1900 veh/lane/hr and 1750 veh/lane/hr were assigned to queue links representing through and turning traffic movements, respectively. These values are typical of the traffic conditions found in the project study area (Korve, 1994d) and correspond to assumptions made in the traffic analysis (PBQ&D, 1994d). A volume-weighted average of saturation flow rate was calculated from the above values for those queue links used to represent combination through-turning lanes.

Signal type is an optional CAL3QHC parameter that describes the operating mode of the traffic signal. The three signal types are:

1 = pretimed;

2 = actuated; and

3 = semiactuated.

The default condition, pretimed, is typical of urban intersections (EPA, 1992) and was employed in this analysis at those intersections known to have synchronized (i.e., pretimed) signals resulting in favorable vehicle progression. Signal type was specified as actuated at all intersections not considered to be part of a coordinated signal system. Direct input from the project traffic engineers (Korve, 1994a) guided the assignment of signal type at each intersection. Signal type conditions assigned in this analysis are presented in Table 5-9.

Vehicle arrival type describes the general way in which the vehicle platoon arrives at an intersection. The five arrival types are (EPA, 1992b):

1 = worst platoon condition (dense platoon arriving at the beginning of the red phase);

2 = unfavorable platoon condition (dense or dispersed platoon arriving during the red phase);

3 = average condition (random arrivals);

4 = moderately favorable platoon condition (dense or dispersed platoon arriving during the green phase); and

5 = most favorable platoon condition (dense platoon arriving at the beginning of the green phase).

Table 5-9
Intersection Signal Type and Arrival Type

North/South Street - East/West Street	Signal Type(1)	A.M./P.M. Arrival Type(2) NB	SB	EB	WB
El Camino Real/Hickey Boulevard	2	3/3	3/3	3/3	3/3
Sneath Lane/I-280 SB ramps	2	3/3	3/3	3/3	3/3
Mission Road/Evergreen Drive	NA(6)	NA	NA	NA	NA
Mission Road/"new street"	NA	NA	NA	NA	NA
El Camino Real/"new street"	2	3/3	3/3	-	3/3
Mission Road/Grand Avenue	NA	NA	NA	NA	NA
Chestnut Avenue/Grand Avenue	2	3/3	3/3	3/3	3/3
Mission Road/Oak Avenue(3)	2	3/3	3/3	3/3	3/3
El Camino Real/Arroyo Drive	1	5/4	4/5	3/3	3/3
Junipero Serra Blvd./Westborough	2	3/3	3/3	3/3	3/3
El Camino Real/Westborough	1	5/4	4/5	3/3	3/3
El Camino Real/So. Spruce Avenue	1	5/4	4/5	3/3	3/3
El Camino Real/Sneath Lane	1	5/4	4/5	3/3	3/3
Huntington Avenue/Sneath Lane(4)	2	3/3	3/3	3/3	3/3
El Camino Real/San Bruno Avenue	1	5/4	4/5	3/3	3/3
San Mateo Avenue/San Bruno Avenue	2	3/3	3/3	3/3	3/3
2nd Avenue/San Bruno Avenue(5)	NA	NA	NA	NA	NA
San Mateo Avenue/Huntington Avenue	2	3/3	3/3	3/3	3/3
Huntington Avenue/Angus Avenue	NA	NA	NA	NA	NA
El Camino Real/Center Street	1	5/4	4/5	3/3	3/3
El Camino Real/Millbrae Avenue	2	3/3	3/3	3/3	3/3
Rollins Road/Millbrae Avenue	1	5/4	4/5	3/3	3/3
El Camino Real/Murchison Drive	2	3/3	3/3	3/3	3/3
California Drive/Broadway	2	3/3	3/3	3/3	3/3

Notes:

1) Signal type: 1 = pretimed;
2 = actuated; and
3 = semiactuated.

2) Arrival type: 1 = worst platoon condition;
2 = unfavorable platoon condition;
3 = average condition;
4 = moderately favorable platoon condition; and
5 = most favorable platoon condition.

3) Mission Road/Oak Avenue is signalized under Alternative III only.
4) Huntington Avenue/Sneath Lane is signalized under the proposed project, Alternative III, and Alternative VI only.
5) 2nd Avenue/San Bruno Avenue is signalized under Alternatives IV, V, and VI, and Design Option V-B only.
6) NA means not applicable; intersection is not signalized.

The default condition, average (random), was specified at all intersections not considered to be part of a coordinated signal system. Moderately favorable or most favorable conditions were specified at those intersections known to have synchronized signals resulting in favorable vehicle progression. Direct input from the project traffic engineers (Korve, 1994b) guided the assignment of arrival type at each intersection. Arrival type conditions assigned in this analysis are presented in Table 5-9.

Unsignalized Intersections

Unsignalized intersection traffic data were provided by PBQ&D (1994b). These data consisted of:

- intersection lane configuration;
- traffic movement volumes; and
- LOS designation for each critical movement.

CALINE4. CALINE4 was the preferred model for this type of intersection, based on the goal of consistency with the earlier analysis in the AA/DEIS/DEIR. However, geometry constraints, as described in Section 5.5.2, dictated the use of CAL3QHC in every case.

CAL3QHC. By default, CAL3QHC was employed for local CO analysis at unsignalized intersections. However, the CAL3QHC queue link variables, such as signal cycle duration, red time duration, signal type, and so on, are not compatible with unsignalized intersection analysis. Therefore, vehicle queues at unsignalized intersections were instead modeled with free flow links. Input variables assigned to normal free flow links, i.e., those free flow links not representing vehicle queues, were determined according to the procedures discussed above for signalized intersections. The procedures followed in modeling vehicle queues with free flow links are described below. The traffic-related inputs for these "queue" links consisted of traffic volume (veh/hr), emission factor (g/veh-mi), and length.

Traffic volumes on "queue" links were obtained from PBQ&D (1994b). Emission factors were calculated with the compositing program ENV028F from EMFAC7F impact rates, as discussed in Section 5.5.3. The 3-mph emission factors (g/veh/mi) were assigned to the "queue" links; the 3-mph factors are the distance-rate equivalent of the idling emission factors.

Length of "queue" links at unsignalized intersections were determined using the procedures given in Chapter 10 of the *1994 Highway Capacity Manual* (HCM) (FTA, 1993a). The unsignalized intersection capacity analysis presented in the 1994 HCM is too lengthy to be repeated here, however, the procedure is briefly summarized as follows:

1) determine the potential capacity of each critical traffic movement;

2) calculate the actual capacity of each critical movement, considering conflicting traffic volumes;

3) calculate the average stopped delay for each critical movement as a function of movement volume and capacity; and

4) determine vehicle queue length as a function of volume to capacity ratio and approach volume.

The length of each "queue" link was calculated by multiplying the number of queued vehicles, as predicted with the above method, by 25 feet per vehicle. This length per vehicle is representative of those reported by Messer and Fambro and by Herman et al., as referenced by Bonneson (1992).

All-Way Stop Intersections - CALINE4 Inputs

All-way stop intersection traffic data were provided by PBQ&D (1994c). These data consisted of:

- intersection lane configuration;
- traffic movement volumes; and
- LOS designation for the intersection as a whole.

CALINE4 was the preferred model for local CO analysis of all-way stop intersections and was employed at every such intersection.

There are essentially two types of CALINE4 links: non-intersection links and intersection links. The input variables associated with non-intersection links were determined according to the procedures discussed above for signalized intersections. This section discusses the adaptation of the CALINE4 intersection link option for modeling vehicle queues at all-way stop intersections.

The traffic-related CALINE4 intersection link variables of cruise speed, deceleration and acceleration times, approach and depart volumes, and composite emission factors were determined according to the procedures discussed above for signalized intersections. The remaining parameters describe the queuing, or vehicle delay, conditions at the intersection: maximum and minimum vehicle idle times, number of vehicles handled per cycle, and number of vehicles delayed per cycle. The procedures followed for calculating these values at an all-way stop intersection are discussed below.

The all-way stop intersection was treated as an over-capacity situation, with the number of vehicles handled per cycle, NCYC, equal to one (only one vehicle clears the stop line at a time) and the number of vehicles delayed per cycle, NDLA, equal to the number of vehicles queued at the stop sign. A very simple estimate of the number of vehicles delayed at the stop sign was made from:

$$\mathrm{NDLA} = \frac{\mathrm{VPHL} \times 3 \times \mathrm{n}}{3600} \tag{5-11}$$

where:

3 = time required for one vehicle to clear intersection (s/appr);
n = number of approaches (appr); and
3600 = conversion factor (s/hr).

Equation 5-11 assumes that a vehicle requires three seconds to accelerate from the stop line and clear the intersection. This value was recommended by the project traffic engineer (Korve, 1994d). The longest possible wait at the stop line is therefore three seconds times the number of approaches; Equation 5-11 calculates the number of vehicles that arrive during this period, based on the approach volume. Note that the equation is technically not valid if the queue length exceeds one vehicle; however, the approach volumes at every all-way stop intersection considered in this analysis were so low that the value of NDLA calculated by Equation 5-11 never exceeded one vehicle, and therefore no error was incurred.

The maximum vehicle idle time, IDT1, was calculated on the basis that a vehicle must wait 3 times n seconds for every vehicle in the queue, including itself:

$$IDT1 = NDLA \times 3 \times n \qquad (5\text{-}12)$$

Under steady state conditions, every vehicle on a given approach experiences the same delay. Therefore, the minimum vehicle idle time, IDT2, was set equal to IDT1:

$$IDT1 = NDLA \times 3 \times n \qquad (5\text{-}13)$$

where:

IDT2 = minimum vehicle idle time (s).

All-Way Stop Intersections - CAL3QHC Inputs

CAL3QHC was not employed for local CO impacts analysis at any all-way stop intersections.

5.5.7 Receptor Locations

In California, past NEPA/CEQA microscale CO analyses of traffic intersections have placed receptors at actual sensitive receptor locations such as nearby residential areas, schools, hospitals, etc. The MTC project sponsor guidance for Resolution No. 2270 (MTC, 1991b) and draft conformity analysis guidance (MTC, 1994) recommend placement of receptors at actual sensitive receptor locations.

Sensitive receptor locations along the BART project corridor include residential areas, with children and/or elderly. Residential areas are located near a number of the traffic intersections and BART station parking facilities in the project corridor. The closest residential receptor location to any modeled intersection is a residential building at the corner of Grand and Chestnut Avenues. Other sensitive receptor locations are the El Camino High School, located immediately northeast of the intersection of Mission Road and Evergreen Avenue, and the Kaiser Permanente Medical Center, near the intersection of Mission Road and Grand Avenue.

The EPA, however, in *Guideline for Modeling Carbon Monoxide from Roadway Intersections* (EPA, 1992a), instead recommends placement of receptors at artificial locations on each side of the approach and depart links for the intersection of interest. The EPA final conformity rule references this document as appropriate guidance for localized CO impact modeling.

For this analysis, an artificial receptor placement scheme was selected, following current EPA guidance. The planned use of artificial receptors was documented in the air quality impact analysis protocol submitted for agency review (Ogden, 1993 and 1994); the BAAQMD was supportive of this strategy in their review comments. The rationale for artificial receptor placement was twofold. First, the use of artificial receptors represents a conservative (i.e., worst case) analysis of each intersection. The receptor placement strategy, described below, was intentionally designed to ensure that the worst-case CO impact locations at each intersection were modeled. Actual sensitive receptor locations will have lesser CO impacts than the specified artificial locations, due to increased distance from the intersection of interest. Second, the consistent placement of artificial receptors allows proper comparison of predicted impacts under different BART alternatives and at different intersections.

The CALINE4 receptor placement methodology was developed from current EPA guidance and from experimental determination of the location of maximum CO concentrations. Twenty

receptors were employed for each CALINE4 run (the maximum number permitted), five per quadrant. All receptors were located 15 feet from the edge of the traveled way. In each quadrant, receptors were placed along the approach leg at distances equal to 15 feet, 25 meters, and 50 meters from the cross street. The fourth receptor in each quadrant was placed along the approach leg at the end of the vehicle queue. The absolute location of this "floating" receptor changed with each run; the position relative to the vehicle queue was held constant. The remaining receptor in each quadrant was positioned along the cross street, at a distance equal to 25 meters from the approach leg. The CALINE4 receptor placement methodology is illustrated in Figure 5-2.

The CAL3QHC receptor placement scheme includes the CALINE4 receptor locations described above, plus an additional 10 receptors per quadrant for a total of 60 (the maximum number allowed). Additional fixed receptors were placed along each approach leg at distances equal to 37.5 and 62.5 meters from the cross street, and along each depart leg at distances equal to 25, 37.5, 50, and 62.5 meters from the cross street. Additional floating receptors were placed along the approach leg at distances equal to 0.50, 0.75, and 1.25 times the vehicle queue length, measured from the stop line. The CAL3QHC receptor placement methodology is illustrated in Figure 5-3.

5.5.8 Impact Estimation

"Net" and "cumulative" worst-case 1-hour and 8-hr average concentrations were estimated at 24 roadway intersections under A.M. and P.M. peak traffic conditions in each forecast year. Estimation of net and cumulative concentrations is described below.

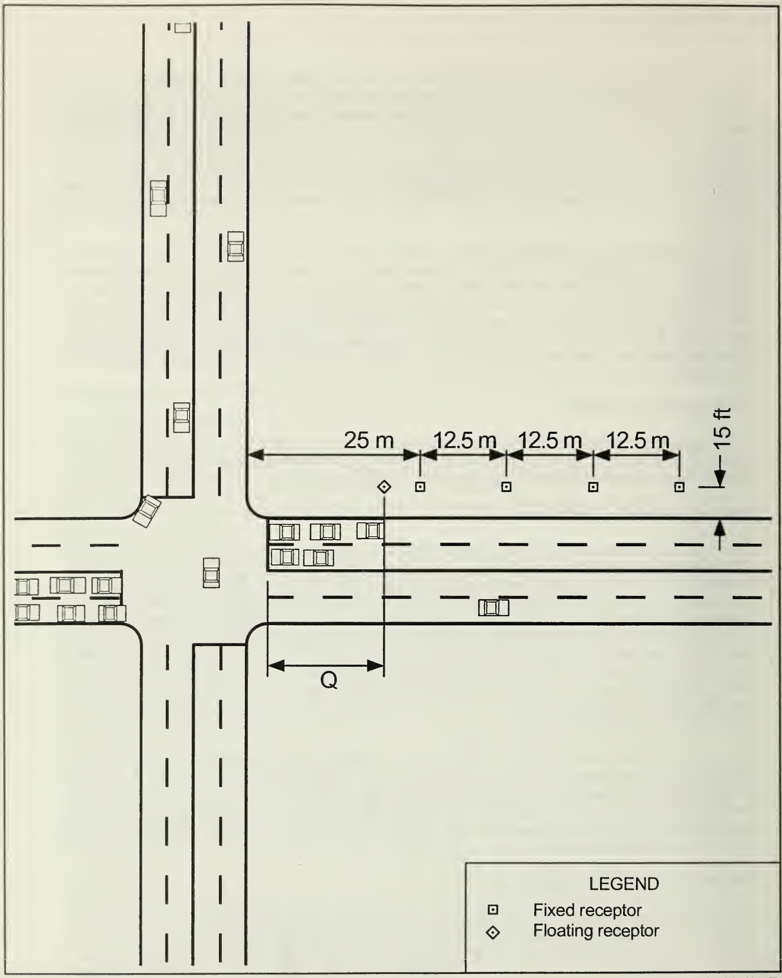
Net and Cumulative Definitions

For a given intersection, BART build alternative, analysis year, and peak hour, net or "BART-only" concentration is defined as the highest predicted CO concentration (not including background) at any receptor location minus the predicted CO concentration under the TSM Alternative at the same receptor location, plus the ambient background concentration. The rationale for this approach to calculating BART-only concentration is that the traffic attributable to normal background growth and that attributable to the TSM Alternative are already implicitly included in the traffic data for each BART build alternative. Thus, the model output for any BART build alternative actually represents the cumulative concentration resulting from BART, TSM, and normal background traffic, rather than the BART-only traffic. The net CO calculation isolates the BART-only incremental CO concentration by subtracting the concentration attributable to non-BART traffic.

For a given intersection, alternative, analysis year, and peak hour, cumulative concentration is defined as the highest predicted CO concentration (not including background) plus the ambient background concentration. Therefore, for any BART build alternative, the cumulative concentration represents the total CO concentration, incorporating the contributions from normal background traffic, traffic attributable to the TSM Alternative, and traffic attributable specifically to that BART build alternative.

One-hour Average Concentrations

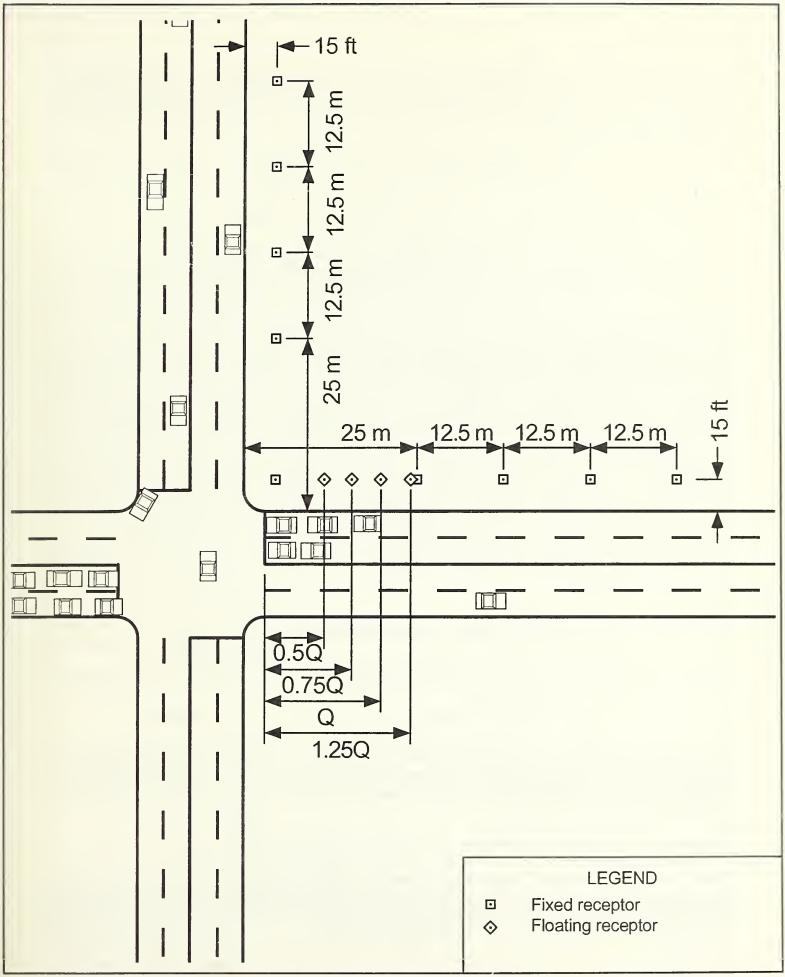
Worst-case 1-hour average CO concentrations were estimated using the CALINE4 or CAL3QHC microscale air quality model as described above. Given traffic data, intersection geometry, CO emission factors, and default meteorological data as input, both models produce worst-case 1-hour average CO concentrations at specified receptor locations for a given roadway intersection. The direct model output does not include the background CO concentration.



OGDEN

CALINE4 Receptor Locations

FIGURE 5-2



OGDEN

CAL3QHC Receptor Locations

FIGURE 5-3

For a given intersection, alternative, analysis year, and peak hour, the 1-hour cumulative concentration was calculated by adding the 1-hour average CO concentration at the worst-case receptor (i.e., the highest model-predicted concentration) to the 1-hour background CO value specific to that forecast year:

$$C_{C,\,1\text{-hr}} = C_{1\text{-hr}} + B_{1\text{-hr}} \tag{5-14}$$

where:

$C_{C,\,1\text{-hr}}$ = worst-case cumulative 1-hour concentration (ppm);
$C_{1\text{-hr}}$ = one-hour concentration at worst-case receptor (ppm); and
$B_{1\text{-hr}}$ = one-hour background concentration for given year (ppm).

The resultant value represents the worst-case curbside CO concentration predicted to occur at that intersection at any location, including nearby sensitive receptor locations, over a 1-hour averaging period, considering background CO levels, background traffic-related CO emissions, and BART-specific traffic emissions. The cumulative concentration estimate is compared against the 1-hour average CO ambient air quality standard to determine if the project, in conjunction with other existing conditions, will contribute to any exceedance of the standard.

For a given intersection, BART build alternative, analysis year, and peak hour, the 1-hour net concentration was calculated as the predicted 1-hour average CO concentration at the worst-case receptor less the predicted 1-hour average CO concentration under the TSM Alternative at the same receptor location; the difference, representing the concentration specifically attributable to BART traffic, was added to the 1-hr background CO concentration for that forecast year:

$$C_{N,\,1\text{-hr}} = \left(C_{1\text{-hr}} - C_{TSM,\,1\text{-hr}}\right) + B_{1\text{-hr}} \tag{5-15}$$

where:

$C_{N,\,1\text{-hr}}$ = worst-case net 1-hour concentration (ppm);
$C_{1\text{-hr}}$ = one-hour concentration at worst-case receptor (ppm);
$C_{TSM,\,1\text{-hr}}$ = one-hour concentration under TSM alternative at the same receptor (ppm); and
$B_{1\text{-hr}}$ = eight-hour background concentration for given year (ppm).

This approach resulted in the highest (most conservative) estimate of the BART-only CO concentration. The net concentration is compared against the 1-hour average CO ambient air quality standard in the NEPA/CEQA analysis to determine if the project, by itself, will contribute to any exceedances of the standard.

Eight-hour Average Concentrations

Worst-case 8-hour average concentrations were predicted from the 1-hour results using a persistence factor approach, as recommended by EPA (1992a). The persistence factor represents the relationship between 1-hour and 8-hour average concentrations at a specific location, considering local meteorological and background conditions.

For a given intersection, alternative, analysis year, and peak hour, the 8-hour cumulative concentration was calculated from:

$$C_{C,\,8\text{-hr}} = C_{1\text{-hr}} \times PF + B_{8\text{-hr}} \tag{5-16}$$

where:

$C_{C,\,8\text{-hr}}$ = worst-case cumulative 8-hour concentration (ppm);
$C_{1\text{-hr}}$ = one-hour concentration at worst-case receptor (ppm);
PF = persistence factor (unitless); and
$B_{8\text{-hr}}$ = eight-hour background concentration for given year (ppm).

Section 4.7.2 of *Guideline for Modeling CO from Roadway Intersections* (EPA, 1992a) recommends a default value of 0.7 for the persistence factor when no local monitoring data are available. However, the guideline states that "if a persistence factor other than 0.7 is obtained through the use of monitored data in a local area, it should be used rather than 0.7."

For this analysis, a local persistence factor of 0.59 was used to estimate worst-case 8-hour concentrations. This value was obtained from the Caltrans publication *Development of Worst-Case Meteorological Criteria* (Caltrans, 1985), which presents persistence factor data for specific locations throughout California. The methodology used by Caltrans to develop location-specific persistence factors closely matches the EPA-recommended approach, and the data set used by Caltrans was significantly larger than the minimum set recommended by EPA. Although the California Data Set used in the Caltrans analysis is somewhat older than recommended by the EPA, it encompasses more than 112 station-years of observations and shows little variation in local persistence factors from year-to-year.

The persistence factor of 0.59 was calculated by Caltrans from data collected at the Redwood City monitoring location. Use of the Redwood City persistence factor is consistent with the use of Redwood City data for definition of local background CO levels, as discussed in Section 5.3. Additionally, this value is consistent with the value of 0.58 provided for the San Francisco Bay Area as a whole, calculated using data from 17 stations.

For a given intersection, BART build alternative, analysis year, and peak hour, the 8-hour net concentration was calculated from:

$$C_{N,\,8\text{-hr}} = \left(C_{1\text{-hr}} - C_{TSM,\,1\text{-hr}}\right) \times PF + B_{8\text{-hr}} \tag{5-17}$$

where:

$C_{N,\,8\text{-hr}}$ = worst-case net 8-hour concentration (ppm);
$C_{1\text{-hr}}$ = one-hour concentration at worst-case receptor (ppm);
$C_{TSM,\,1\text{-hr}}$ = one-hour concentration under TSM Alternative at the same receptor (ppm);
PF = persistence factor (unitless); and
$B_{8\text{-hr}}$ = eight-hour background concentration for given year (ppm).

The net concentration is compared against the 8-hour average CO ambient air quality standard in the NEPA/CEQA analysis to determine if the project, by itself, will contribute to any exceedances of the standard.

5.6 PARKING AREA ANALYSIS METHODOLOGY

This section describes the methodology for the microscale CO analysis conducted to assess project-related localized CO impacts in the vicinity of BART parking lots or structures at new stations in the project corridor. Parking lot impact analysis is not specifically required by the EPA conformity rules at 40 CFR 93, nor by MTC Resolution No. 2270. Nonetheless, BART-related CO impacts were estimated for the anticipated worst-case parking lot and analysis year for each BART build alternative, at the suggestion of the BAAQMD and for completeness in the NEPA/CEQA analysis. The sections below describe the rationale for the selection of the parking lots included in the analysis and for the selection of the microscale dispersion model used. The technical methodology for estimating vehicular CO emission rates, establishing receptor locations, establishing other model inputs, and executing the model follow. In general, the assumptions made in the parking lot analysis were conservative, selected to represent worst-case conditions. The resulting CO concentrations correspondingly represent worst-case predictions of impacts.

5.6.1 Selection of Parking Areas and Analysis Year

The original Air Quality Analysis Protocol (Ogden, 1993) did not include impact analysis in the immediate vicinity of BART parking lots. (That document outlined the intended analysis methodology, and was submitted to local regulatory agencies for review at the outset of the environmental analysis.) Based on comments received from the BAAQMD, BART opted to complete a worst-case air quality impact analysis for the parking lots and analysis year anticipated to cause the worst-case (highest) localized CO impacts.

Only parking areas proposed under BART build alternatives were considered in this analysis, since the BART-related impacts at currently non-existent stations will be greater than those at existing station parking areas that may result from changes in traffic patterns. The 1993 analysis base year was not considered, as new parking lots associated with the BART build alternatives are not in existence. For each BART build alternative, the traffic analysts provided worst-case vehicular data for new parking lots in the form of total vehicle arrival estimates for the A.M. peak hour and total vehicle departure estimates for the P.M. peak hour. Data were provided by the traffic analysts for the 1998 forecast year only, based on 1) the sharp decrease in predicted vehicular CO emission rates in the later forecast years (2000 and 2010), and 2) the relatively small increase in predicted BART station traffic in the later forecast years, based on review of preliminary estimates of peak hour data for all forecast years for a subset of the parking lots. The rationale for selecting the 1998 forecast year for parking lot analysis is discussed further below.

Vehicular CO emission rates are estimated by EMFAC7 to decline in future years, largely due to the continual introduction of new, low-emitting vehicles (due to stricter emissions standards, cleaner-burning fuels, advances in control technology, etc.) and the phasing-out of older, higher-emitting vehicles. Estimated CO emission rates are substantially higher in 1998 than in years 2000 and 2010. Preliminary traffic data did not show substantial increase in traffic volumes at BART parking areas in future years. The sharp reduction in CO emission rates in future years is expected to outweigh the estimated BART-related increases in vehicular traffic at the station parking areas, resulting in a reduction of total mass emissions of CO from parking lot-related traffic. This analysis is supported by the results of the intersection-level modeling, which predicts CO impacts to decline in future years even as traffic increases. Therefore, 1998 was selected as the predicted worst-case year for parking area impacts. The CO impacts for future years would be expected to be lower, and therefore no analysis was completed for those years.

To identify the anticipated worst-base parking lot for each BART build alternative, the traffic data were examined in conjunction with each preliminary parking lot design as provided by Bay Area Traffic Consultants (BATC) (1993 and 1994). The largest parking lots or structures with the greatest volume of associated traffic were selected for analysis, with traffic volume being the overriding consideration. It is reasonable to assume that this combination would represent the worst-case scenario for air quality impacts. Table 5-14 shows the parking areas evaluated for each alternative and includes the associated peak-hour traffic data used in the analysis. The total vehicle counts include traffic in the "kiss-and-ride" areas, in addition to the traffic entering/leaving the commuter parking areas.

5.6.2 Dispersion Model Selection and Description

CAL3QHC was designed by the EPA specifically for estimation of impacts in the vicinity of intersections or free-flow roadway links (such as highway segments), and is not suitable for modeling emissions from an area source such as a parking garage or lot. Although Caltrans has published guidance to adapt CALINE4 for parking lot analysis (Caltrans, 1989b), CALINE4 is limited by the number of links allowed as input and therefore is arguably inadequate to model large, multilevel structures such as those in this analysis. Caltrans recommends ISC2 as an alternative.

The ISC2 model (short-term version) is an EPA-approved air quality dispersion model included in the *Guideline on Air Quality Models, Revised* (EPA, 1987). The latter document is referenced as the appropriate modeling guidance in the EPA conformity regulation. ISC2 was designed to allow both ground-level and elevated area emission sources (such as parking lots or garages) to be modeled, whereas both CAL3QHC and CALINE4 must treat an area as a series of line sources. ISC2 also accepts long-term sets of site-specific hourly meteorological data, more accurately reflecting site-specific meteorological conditions and source/receptor relationships, especially over an 8-hour averaging period. Therefore, ISC2 was selected as the most appropriate model for use in this analysis.

The user describes the physical conditions to be modeled with input variables that specify the vehicular CO emission rate, site-specific meteorological conditions, geometry of the parking lot emission source(s), and the location of receptors at which impacts are to be estimated. This input data are used by the model to calculate worst-case impacts for user-specified averaging periods at each receptor point. Eight-hour averaging times were specified for this analysis.

5.6.3 Vehicular Emission Rates

Vehicular CO emission rates ($g/s/m^2$) were calculated from EMFAC7F impact rates using the methodology presented in Section 6.3 of *CALINE4 – A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways* (Caltrans, 1989b). This procedure accounts for the excess transient CO emissions produced by vehicles in the start-up phase, as described in Section 5.5.3.

The vehicle category mix at BART parking areas was assumed to consist solely of light-duty automobiles and light-duty trucks, in the same relative proportions as occurring in the San Mateo County VMT data provided in Table 5-6. All vehicles were assumed to be in cold start transient mode; this assumption is discussed futher in the following paragraph. Other emission factor assumptions (temperature, season, and I/M designation) were consistent with those made in the calculation of composite CO factors for roadway intersection modeling, as described in Section 5.5.3.

All vehicles at the BART parking area were assumed to be operating in cold start transient mode. As described in Section 5.5.3, cold start transient emissions are considerably higher than hot stabilized (warmed up) emissions; therefore, the assumption made here that 100 percent of the parking area vehicles are operating in cold start mode is most conservative. The fraction of transient starting emissions that occur within the parking area (as opposed to the fraction that occurs after the vehicle(s) leave the parking area) is a function of vehicle egress time. The estimated egress time from each parking area was based on the assumption of 1) a 30-second idling period, 2) travel at 5 mi/hr from the most remote area of the parking structure/lot to the exit, and 3) a 15-second delay at the exit. Composite CO emission rates (g/veh exit) were calculated from Equation 6-20 in *CALINE4 – A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways.*

Carbon monoxide emission rates (g/s/m^2) required as ISC2 input were calculated from the per-exit rates described above, the peak-hour exiting traffic volume as provided by the traffic consultant, and the size (area) of the parking structure or lot. Conservatively, the CO emission rates corresponding to peak-hour exit volumes were assumed constant over the entire 8-hour averaging period.

5.6.4 Meteorological Data

Meteorological data are required as input to the ISC2 model. For this analysis, 1991 and 1992 hourly meteorological data sets from the SFIA were obtained from the EPA (1994c). To select the worst-case data set for use in subsequent model runs, both sets were input independently for a test-case parking lot with other required inputs held constant. The data set generating worst-case 8-hour average impacts was selected for subsequent use in all other model runs.

5.6.5 Traffic-Related Inputs

No direct traffic-related input variables are required for the ISC2 analysis. Traffic data are used only to estimate total vehicular CO emissions during the peak hour (described above). The total rate is then adjusted using lot-specific configuration and the appropriate unit conversions to the required emission rate form for input to the model.

5.6.6 Parking Area Geometry

The ISC2 model requires that each parking lot area source be represented as a square (or a series of squares). Area source geometry is specified by the user by giving the model coordinates of each corner of the area relative to a known and consistent origin point, and specifying the length of the side. Alternative-specific BATC design drawings of each parking were used to develop the model inputs to approximate actual lot configurations as closely as possible. For multiple-story structures, each floor was modeled as a separate source with a source elevation reflecting the actual structure design specified as input, using data provided by BATC.

5.6.7 Receptor Locations

Site-specific artificial receptor locations were established for each parking lot modeled. As with the intersection-level analysis, no specific sensitive receptors were included. The analysis was designed to identify the site-specific worst-case impact location; by definition, the CO concentrations likely to occur at actual sensitive receptor locations would be less than those predicted in this analysis.

For each specific alternative/lot combination, a receptor grid with a 20-meter grid spacing was established around the area source representing the parking lot, with the closest receptors located

approximately two meters away from the outside limit of the parking lot or structure. These closest receptor locations were intended as a reasonable approximation of actual future sidewalk locations since no final design data was available showing sidewalk placements. Receptor height was specified as five feet to represent the breathing zone; this height corresponds to that used in the intersection-level analysis. The remaining grid receptors were placed with the intention of ensuring that the worst-case impact location was included, as a conservative approach.

5.6.8 Model Sensitivity to Input Assumptions

Specific observations regarding the effects of certain input assumptions on model results in this application are described below.

The assumption that vehicular emissions are evenly distributed throughout the hour does not affect the accuracy of the model nor result in under-prediction of impacts, because the model averages the concentrations over each hour.

Peak-hour traffic conditions were assumed to persist throughout the 8-hour averaging period. This conservative assumption results in an over-prediction of impact, since in reality less traffic is present in off-peak hours.

The model algorithm internally identifies the worst-case 8-hour time period based on meteorological conditions and source/receptor geometry, under the assumption that traffic-related emissions are constant as described above. The worst-case 8-hour average time period may not, in fact, correspond with the hours during which traffic is actually heaviest, and therefore this approximation likely results in a conservative (over predicted) estimate of impact.

The area source algorithm in ISC2 models total emissions from a given area emission source as if occurring from a line source located at the leading edge of the area (closest to the receptor of interest). The effect of this approximation is readily seen in model predictions: for a given downwind receptor, the model predicts higher concentrations when the area source is represented by a single large area than when the area is represented by a conglomeration of smaller squares that total to the same overall area. This is because the majority of emissions from the single source are seen by the model as physically closer to the receptor. Mathematically, the optimal way to assign the area source inputs to the model would be to input an infinite number of sources (with each source thereby essentially representing a point), thus describing the actual physical situation exactly and eliminating the effect of this internal model approximation. In practice, this is impossible, and the user makes a reasonable approximation of the total area by representing it as a finite and manageable number of smaller areas as input to the model. The source input data specification used in this analysis was designed to provide conservative results based on representation of each parking lot as a conglomeration of a relatively small number of individual area sources.

5.6.9 Impact Estimation

The worst-case 1-hour average CO concentration was estimated for each parking lot/alternative combination by adding the highest predicted 1-hour average concentration to the 1998 1-hour average CO background level of 8.6 ppm (see Section 5.3). The result is the worst-case cumulative 1-hour average CO concentration. The BART-specific or net impact is assumed equal to the cumulative result, since all traffic at new BART station parking areas is assumed to be project-related.

The worst-case 8-hour average CO concentration was estimated for each parking lot/alternative combination by adding the highest predicted 8-hour average concentration to the 1998 8-hour

average CO background level of 3.5 ppm (see Section 5.3). The result is the worst-case cumulative 8-hour average CO concentration. The BART-specific or net impact is assumed equal to the cumulative result, since all traffic at new BART station parking areas is assumed to be project-related.

5.7 Results

This section presents the results of the microscale CO analysis at roadway intersections and at BART parking areas.

5.7.1 Intersection Analysis

Tables 5-10, 5-11, 5-12, and 5-13 show the predicted worst-case cumulative 1-hour and 8-hour average CO concentrations at roadway intersections under each BART alternative in calendar years 1993, 1998, 2000, and 2010, respectively. As defined in Section 5.5.8, cumulative concentrations represent the ambient, or background, CO concentration plus the predicted contribution from normal background traffic and from BART-specific traffic. These results must be considered to be a worst-case prediction, given the conservative nature of the modeling approach. For comparison, the federal and California ambient air quality standards for CO are 9 and 9.0 ppm (8-hour average) and 35 and 20 ppm (1-hour average), respectively. Cumulative impacts for the 1998, 2000, and 2010 forecast years, in which the BART extension is proposed to actually be in service, are not predicted to exceed the air quality standards at any location.

For a given intersection, BART alternative, and forecast year, net impact was defined in Section 5.5.8 as the highest predicted curbside CO concentration less the CO concentration under the TSM Alternative at the same receptor location, plus the year-specific background concentration. Worst-case net 1-hour and 8-hour average CO impacts are included in the DEIR/Technical Appendix, and have not been repeated here.

Analysis of the significance of these results in the NEPA/CEQA framework is also included in the DEIR/Technical Appendix, and is not appropriate for inclusion in this technical report.

5.7.2 Parking Lot Analysis

Table 5-14 shows the predicted 1998 worst-case cumulative 1-hour average and 8-hr average CO concentrations for each parking lot evaluated. BART-specific or net concentrations are assumed equal to the cumulative concentrations, since all BART parking area traffic can reasonably be assumed to be BART-related. CO impacts in 1998 at other BART parking lots in the area substantially affected by the project are not expected to exceed these values, as discussed earlier. Neither are impacts in other analysis years expected to exceed these worst-case estimates.

5.7.3 Conformity Discussion

The applicability of EPA and MTC air conformity criteria and requirements for projects was discussed in Section 2 of this technical report. In summary, the applicable MTC Resolution No. 2270 criteria for air conformity for this project are:

- the project must be included in a plan or program (i.e., a TIP or RTP) that has been found to conform;

Table 5-10
1993 Cumulative CO Concentrations

Intersection	1993 Cumulative CO Impact (ppm) No Build		1993 Cumulative CO Impact (ppm) LPA		No Build		TSM		Base Case		Alt. IV		Alt. V		Des. Opt. V-B		Alt. VI	
	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hr	8-hr
El Camino Real/Hickey Boulevard	**20.1**	**9.9**	**22.3**	**11.2**	**20.1**	**9.9**	**22.4**	**11.3**	**20.8**	**10.3**	**21.6**	**10.8**	**21.6**	**10.8**	**22.4**	**11.3**	**22.2**	**11.2**
I-280 southbound ramps/Sneath Lane	13.6	6.1	13.7	6.1	13.6	6.1	13.7	6.1	13.9	6.3	13.7	6.1	13.7	6.1	13.7	6.1	13.8	6.2
Mission Road/Evergreen Drive	**18.6**	**9.0**	**16.1**	**7.6**	**18.6**	**9.0**	**19.8**	**9.7**	**19.2**	**9.4**	**16.1**	**7.6**	**16.1**	**7.6**	**16.1**	**7.6**	**16.2**	**7.6**
Mission Road/"new street"	NA	NA	16.8	8.0	NA	NA	NA	NA	NA	NA	16.9	8.0	16.9	8.0	26.4	13.6	16.7	7.9
El Camino Real/"new street"	**NA**	**NA**	**18.9**	**9.2**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**20.0**	**9.9**	**20.0**	**9.9**	**19.5**	**9.6**	**18.0**	**8.7**
Mission Road/Grand Avenue	20.0	9.9	19.5	9.6	20.0	9.9	20.8	10.3	21.4	10.7	19.5	9.6	19.5	9.6	19.7	9.7	19.3	9.5
Chestnut Avenue/Grand Avenue	**17.5**	**8.4**	**17.5**	**8.4**	**17.5**	**8.4**	**17.8**	**8.6**	**18.5**	**9.0**	**17.9**	**8.6**	**17.9**	**8.6**	**17.9**	**8.6**	**18.5**	**9.0**
Mission Road/Oak Avenue	11.2	4.7	10.9	4.5	11.2	4.7	11.2	4.7	15.9	7.4	10.9	4.5	10.9	4.5	11.0	4.6	11.0	4.6
El Camino Real/Arroyo Drive	**15.6**	**7.3**	**15.6**	**7.3**	**15.6**	**7.3**	**15.5**	**7.2**	**21.7**	**10.9**	**15.6**	**7.3**	**15.6**	**7.3**	**15.8**	**7.4**	**15.5**	**7.2**
Junipero Serra Boulevard/Westborough Blvd.	18.7	9.1	18.8	9.2	18.7	9.1	18.6	9.0	19.0	9.3	18.6	9.0	18.6	9.0	18.7	9.1	18.8	9.2
El Camino Real/Westborough Boulevard	**20.6**	**10.2**	**21.0**	**10.5**	**20.6**	**10.2**	**20.6**	**10.2**	**20.9**	**10.4**	**21.0**	**10.5**	**21.1**	**10.5**	**21.0**	**10.5**	**20.9**	**10.4**
El Camino Real/South Spruce Avenue	18.2	8.8	18.1	8.7	18.2	8.8	18.1	8.7	18.1	8.7	18.1	8.7	18.1	8.7	18.1	8.7	17.5	8.4
El Camino Real/Sneath Lane	**19.2**	**9.4**	**19.9**	**9.8**	**19.2**	**9.4**	**19.2**	**9.4**	**19.7**	**9.7**	**19.2**	**9.4**	**19.2**	**9.4**	**19.3**	**9.5**	**19.3**	**9.5**
Huntington Avenue/Sneath Lane	17.7	8.5	18.4	8.9	17.7	8.5	17.3	8.3	17.6	8.4	18.2	8.8	17.6	8.4	17.7	8.5	18.7	9.1
El Camino Real/San Bruno Avenue	**17.7**	**8.5**	**18.2**	**8.8**	**17.7**	**8.5**	**18.4**	**8.9**	**18.3**	**8.9**	**18.3**	**8.9**	**18.4**	**8.9**	**18.3**	**8.9**	**17.8**	**8.6**
San Mateo Avenue/San Bruno Avenue	17.9	8.6	18.2	8.8	17.9	8.6	18.4	8.9	18.3	8.9	17.5	8.4	17.8	8.6	17.3	8.3	18.6	9.0
2nd Avenue/San Bruno Avenue	**17.8**	**8.6**	**18.0**	**8.7**	**17.8**	**8.6**	**18.5**	**9.0**	**18.2**	**8.8**	**17.2**	**8.2**	**17.7**	**8.5**	**17.1**	**8.2**	**18.5**	**9.0**
San Mateo Avenue/Huntington Avenue	13.0	5.7	13.0	5.7	13.0	5.7	13.5	6.0	12.8	5.6	12.6	5.5	13.1	5.8	13.1	5.8	13.8	6.2
Huntington Avenue/Angus Avenue	**16.8**	**8.0**	**17.8**	**8.6**	**16.8**	**8.0**	**17.5**	**8.4**	**17.5**	**8.4**	**18.1**	**8.7**	**18.0**	**8.7**	**22.5**	**11.3**	**19.4**	**9.5**
El Camino Real/Center Street	18.6	9.0	18.3	8.9	18.6	9.0	19.4	9.5	19.8	9.7	23.4	11.9	23.7	12.0	18.5	9.0	19.2	9.4
El Camino Real/Millbrae Avenue	**16.1**	**7.6**	**16.2**	**7.6**	**16.1**	**7.6**	**16.1**	**7.6**	**16.2**	**7.6**	**15.8**	**7.4**	**15.8**	**7.4**	**20.3**	**10.0**	**16.5**	**7.8**
Rollins Road/Millbrae Avenue	18.4	8.9	ND	ND	18.4	8.9	18.4	8.9	ND	ND	ND	ND	ND	ND	ND	ND	18.2	8.8
El Camino Real/Murchison Drive	**16.7**	**7.9**	**ND**	**ND**	**16.7**	**7.9**	**16.6**	**7.9**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**16.7**	**7.9**
California Drive/Broadway	17.1	8.2	ND	ND	17.1	8.2	17.1	8.2	ND	ND	ND	ND	ND	ND	ND	ND	17.4	8.3

Notes:

1) Federal and State 8-hour standards are 9.0 ppm.
2) Federal 1-hour standard is 35 ppm; State 1-hour standard is 20 ppm.
3) 1993 1-hour background is 10.4 ppm; 1993 8-hour background is 4.2 ppm.
4) NA - Not applicable; intersection does not exist under this alternative.
5) ND - Not analyzed; traffic data were not provided for this alternative since intersection would be unaffected by BART service.
6) Impact shown is the greater of the A.M. and P.M. peak-hour impacts.
7) Full Alternative Names:
   Proposed Project – Locally Preferred Alternative (LPA)
   Alternative I – No Build Alternative
   Alternative II – Transportation Systems Management (TSM)
   Alternative III – BART to Airport Intermodal (Base Case)
   Alternative IV – Airport Aerial East of Highway 101 with I-380/San Bruno Station
   Alternative V – Minimum Length Subway to Millbrae Intermodal with I-380/San Bruno Station
   Design Option V-B – Minimum Length Subway to San Bruno with I-380/San Bruno Station
   Alternative VI – Millbrae Avenue via the Airport International Terminal

Table 5-11
1998 Cumulative CO Concentrations

Intersection	1993 Cumulative CO Impact (ppm) No Build 1-hour	1993 No Build 8-hour	1998 Cumulative CO Impact (ppm) LPA 1-hour	LPA 8-hour	No Build 1-hour	No Build 8-hour	TSM 1-hour	TSM 8-hour	Base Case 1-hour	Base Case 8-hour	Alt IV 1-hour	Alt IV 8-hour	Alt V 1-hour	Alt V 8-hour	Des Opt V-B 1-hour	Des Opt V-B 8-hour	Alt VI 1-hour	Alt VI 8-hour
El Camino Real/Hickey Boulevard	20.1	9.9	16.8	8.3	15.0	7.3	17.0	8.4	15.6	7.6	16.5	8.2	16.9	8.4	16.8	8.3	16.8	8.3
I-280 southbound ramps/Sneath Lane	13.6	6.1	10.8	4.8	10.7	4.7	10.8	4.8	10.7	4.7	10.7	4.7	10.8	4.8	10.7	4.7	10.7	4.7
Mission Road/Evergreen Drive	18.6	9.0	12.4	5.7	14.4	6.9	14.9	7.2	14.5	7.0	12.4	5.7	12.4	5.7	12.4	5.7	12.5	5.8
Mission Road/"new street"	NA	NA	12.9	6.0	NA	NA	NA	NA	NA	NA	13.0	6.1	13.0	6.1	13.0	6.1	12.9	6.0
El Camino Real/"new street"	NA	NA	14.5	7.0	NA	NA	NA	NA	NA	NA	15.0	7.3	15.1	7.3	14.7	7.1	13.7	6.5
Mission Road/Grand Avenue	20.0	9.9	14.8	7.1	15.2	7.4	15.6	7.6	16.0	7.9	14.8	7.2	14.8	7.2	15.0	7.3	14.7	7.1
Chestnut Avenue/Grand Avenue	17.5	8.4	13.9	6.6	13.3	6.3	13.7	6.5	14.2	6.8	13.7	6.5	13.7	6.5	13.7	6.5	13.8	6.6
Mission Road/Oak Avenue	11.2	4.7	8.9	3.7	9.2	3.9	9.1	3.8	12.4	5.7	8.9	3.7	8.9	3.7	8.9	3.7	8.9	3.7
El Camino Real/Arroyo Drive	15.6	7.3	12.2	5.6	11.9	5.4	12.2	5.6	16.3	8.0	12.2	5.6	12.2	5.6	12.2	5.6	12.2	5.6
Junipero Serra Boulevard/Westborough Blvd.	18.7	9.1	14.1	6.7	14.1	6.7	14.1	6.7	14.1	6.7	14.1	6.7	14.1	6.7	14.1	6.7	14.1	6.7
El Camino Real/Westborough Boulevard	20.6	10.2	15.4	7.5	15.4	7.5	15.3	7.5	15.8	7.7	15.4	7.5	15.3	7.5	15.4	7.5	15.4	7.5
El Camino Real/South Spruce Avenue	18.2	8.8	13.9	6.6	14.0	6.7	13.9	6.6	13.9	6.6	13.9	6.6	13.9	6.6	13.9	6.6	13.4	6.3
El Camino Real/Sneath Lane	19.2	9.4	15.0	7.3	14.6	7.0	14.4	6.9	14.7	7.1	14.5	7.0	14.5	7.0	14.5	7.0	14.8	7.2
Huntington Avenue/Sneath Lane	17.7	8.5	13.7	6.5	13.7	6.5	13.2	6.2	13.6	6.4	13.7	6.5	13.5	6.4	13.5	6.4	14.3	6.9
El Camino Real/San Bruno Avenue	17.7	8.5	15.9	7.8	13.9	6.6	13.9	6.6	15.9	7.8	14.5	7.0	14.7	7.6	16.8	8.3	17.2	8.6
San Mateo Avenue/San Bruno Avenue	17.9	8.6	13.8	6.6	13.6	6.5	13.9	6.6	13.8	6.6	13.8	6.6	14.0	6.7	13.7	6.5	14.1	6.7
2nd Avenue/San Bruno Avenue	17.8	8.6	13.7	6.5	13.7	6.5	13.8	6.6	13.9	6.6	13.7	6.5	13.9	6.6	13.6	6.4	14.1	6.7
San Mateo Avenue/Huntington Avenue	13.0	5.7	10.5	4.6	10.1	4.4	10.6	4.7	10.1	4.4	10.5	4.6	10.6	4.7	10.6	4.7	10.9	4.9
Huntington Avenue/Angus Avenue	16.8	8.0	13.6	6.4	13.2	6.2	13.4	6.3	13.5	6.4	13.8	6.6	13.8	6.6	16.7	8.3	14.7	7.1
El Camino Real/Center Street	18.6	9.0	13.9	6.6	13.8	6.6	14.1	6.7	14.9	7.2	16.0	7.9	16.9	8.4	13.9	6.6	14.4	6.9
El Camino Real/Millbrae Avenue	16.1	7.6	12.4	5.7	12.4	5.7	12.6	5.9	12.3	5.7	12.0	5.5	11.9	5.4	12.3	5.7	12.8	6.0
Rollins Road/Millbrae Avenue	18.4	8.9	ND	ND	14.2	6.8	14.2	6.8	ND	ND	ND	ND	ND	ND	ND	ND	13.8	6.6
El Camino Real/Murchison Drive	16.7	7.9	ND	ND	12.9	6.0	13.1	6.2	ND	ND	ND	ND	ND	ND	ND	ND	13.0	6.1
California Drive/Broadway	17.1	8.2	ND	ND	13.3	6.3	13.3	6.3	ND	ND	ND	ND	ND	ND	ND	ND	13.3	6.3

Notes.

1) Federal and State 8-hour standards are 9.0 ppm.
2) Federal 1-hour standard is 35 ppm; State 1-hour standard is 20 ppm.
3) 1993 1-hour background is 10.4 ppm; 1993 8-hour background is 4.2 ppm. 1998 1-hour background is 8.6 ppm; 1998 8-hour background is 3.5 ppm.
4) NA - Not applicable; intersection does not exist under this alternative.
5) ND - Not analyzed; traffic data were not provided for this alternative since intersection would be unaffected by BART service.
6) Impact shown is the greater of the A.M. and P.M. peak-hour impacts.
7) Full Alternative Names:
   Proposed Project – Locally Preferred Alternative (LPA)
   Alternative I – No Build Alternative
   Alternative II – Transportation Systems Management (TSM)
   Alternative III – BART to Airport Intermodal (Base Case)
   Alternative IV – Airport Aerial East of Highway 101 with I-380/San Bruno Station
   Alternative V – Minimum Length Subway to Millbrae Intermodal with I-380/San Bruno Station
   Design Option V-B – Minimum Length Subway to San Bruno with I-380/San Bruno Station
   Alternative VI – Millbrae Avenue via the Airport International Terminal

Table 5-12
2000 Cumulative CO Concentrations

Intersection	1993 Cumulative CO Impact (ppm) No Build 1-hour	8-hour	2000 Cumulative CO Impact (ppm) LPA 1-hour	8-hour	No Build 1-hour	8-hour	TSM 1-hour	8-hour	Base Case 1-hour	8-hour	Alt. IV 1-hour	8-hour	Alt. V 1-hour	8-hour	Des. Opt. V-B 1-hour	8-hour	Alt. VI 1-hour	8-hour
El Camino Real/Hickey Boulevard	**20.1**	**9.9**	**14.8**	**7.2**	**14.0**	**6.8**	**15.0**	**7.4**	**13.8**	**6.7**	**14.6**	**7.1**	**14.9**	**7.3**	**14.9**	**7.3**	**14.8**	**7.2**
I-280 southbound ramps/Sneath Lane	13.6	6.1	9.7	4.3	9.7	4.3	9.7	4.3	9.4	4.1	9.7	4.3	9.6	4.2	9.6	4.2	9.7	4.3
Mission Road/Evergreen Drive	**18.6**	**9.0**	**11.1**	**5.1**	**12.8**	**6.1**	**13.2**	**6.3**	**12.8**	**6.1**	**11.0**	**5.0**	**11.0**	**5.0**	**11.1**	**5.1**	**11.1**	**5.1**
Mission Road/"new street"	NA	NA	11.2	5.1	NA	NA	NA	NA	NA	NA	11.5	5.3	11.6	5.4	11.6	5.4	11.5	5.3
El Camino Real/"new street"	**NA**	**NA**	**12.9**	**6.1**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**13.2**	**6.3**	**13.2**	**6.3**	**12.9**	**6.1**	**12.2**	**5.7**
Mission Road/Grand Avenue	20.0	9.9	13.1	6.3	13.4	6.4	13.7	6.6	14.1	6.9	13.1	6.3	13.0	6.2	13.2	6.3	13.0	6.2
Chestnut Avenue/Grand Avenue	**17.5**	**8.4**	**12.2**	**5.7**	**11.8**	**5.5**	**12.0**	**5.6**	**12.7**	**6.0**	**12.2**	**5.7**	**12.3**	**5.8**	**12.3**	**5.8**	**12.3**	**5.8**
Mission Road/Oak Avenue	11.2	4.7	8.2	3.4	8.4	3.5	8.4	3.5	11.4	5.3	8.2	3.4	8.2	3.4	8.2	3.4	8.2	3.4
El Camino Real/Arroyo Drive	**15.6**	**7.3**	**11.0**	**5.0**	**10.7**	**4.9**	**10.9**	**5.0**	**14.1**	**6.9**	**10.9**	**5.0**	**10.9**	**5.0**	**10.9**	**5.0**	**10.8**	**4.9**
Junipero Serra Boulevard/Westborough Blvd.	18.7	9.1	12.3	5.8	12.2	5.7	12.5	5.9	12.3	5.8	12.4	5.9	12.3	5.8	12.4	5.9	12.3	5.8
El Camino Real/Westborough Boulevard	**20.6**	**10.2**	**13.5**	**6.5**	**13.5**	**6.5**	**13.5**	**6.5**	**13.7**	**6.6**	**13.5**	**6.5**	**13.4**	**6.4**	**13.5**	**6.5**	**13.5**	**6.5**
El Camino Real/South Spruce Avenue	18.2	8.8	12.2	5.7	12.3	5.8	12.2	5.7	12.3	5.8	12.2	5.7	12.3	5.8	12.2	5.7	12.0	5.6
El Camino Real/Sneath Lane	**19.2**	**9.4**	**13.0**	**6.2**	**12.9**	**6.2**	**12.7**	**6.0**	**12.8**	**6.1**	**12.7**	**6.0**	**12.7**	**6.0**	**12.7**	**6.0**	**12.9**	**6.2**
Huntington Avenue/Sneath Lane	17.7	8.5	12.1	5.7	12.2	5.7	11.7	5.4	12.1	5.7	12.1	5.7	12.0	5.6	12.0	5.6	12.5	5.9
El Camino Real/San Bruno Avenue	**17.7**	**8.5**	**14.0**	**6.8**	**12.4**	**5.9**	**12.4**	**5.9**	**14.1**	**6.9**	**12.8**	**6.1**	**12.8**	**6.1**	**14.6**	**7.2**	**14.8**	**7.3**
San Mateo Avenue/San Bruno Avenue	17.9	8.6	12.3	5.8	12.1	5.7	12.2	5.7	12.3	5.8	12.7	6.0	12.7	6.0	12.4	5.9	12.5	5.9
2nd Avenue/San Bruno Avenue	**17.8**	**8.6**	**12.1**	**5.7**	**12.0**	**5.6**	**12.1**	**5.7**	**12.0**	**5.6**	**12.4**	**5.9**	**12.6**	**6.0**	**12.2**	**5.7**	**12.4**	**5.9**
San Mateo Avenue/Huntington Avenue	13.0	5.7	9.5	4.1	9.2	4.0	9.6	4.2	9.3	4.0	9.6	4.2	9.7	4.3	9.6	4.2	9.8	4.3
Huntington Avenue/Angus Avenue	**16.8**	**8.0**	**12.1**	**5.7**	**11.8**	**5.5**	**11.9**	**5.6**	**12.0**	**5.6**	**12.3**	**5.8**	**12.2**	**5.7**	**14.5**	**7.1**	**13.0**	**6.2**
El Camino Real/Center Street	18.6	9.0	12.3	5.8	12.2	5.7	12.4	5.9	13.1	6.3	14.5	7.1	15.0	7.4	12.3	5.8	12.7	6.0
El Camino Real/Millbrae Avenue	**16.1**	**7.6**	**10.9**	**5.0**	**11.2**	**5.1**	**11.2**	**5.1**	**11.1**	**5.1**	**10.6**	**4.8**	**10.8**	**4.9**	**10.9**	**5.0**	**11.5**	**5.3**
Rollins Road/Millbrae Avenue	18.4	8.9	ND	ND	12.4	5.9	12.5	5.9	ND	ND	ND	ND	ND	ND	ND	ND	12.1	5.7
El Camino Real/Murchison Drive	**16.7**	**7.9**	**ND**	**ND**	**11.5**	**5.3**	**11.5**	**5.3**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**11.4**	**5.3**
California Drive/Broadway	17.1	8.2	ND	ND	11.7	5.4	11.7	5.4	ND	ND	ND	ND	ND	ND	ND	ND	11.9	5.6

Notes:

1) Federal and State 8-hour standards are 9.0 ppm.
2) Federal 1-hour standard is 35 ppm; State 1-hour standard is 20 ppm.
3) 1993 1-hour background is 10.4 ppm; 1993 8-hour background is 4.2 ppm. 2000 1-hour background is 7.9 ppm; 1998 8-hour background is 3.2 ppm.
4) NA - Not applicable; intersection does not exist under this alternative.
5) ND - Not analyzed; traffic data were not provided for this alternative since intersection would be unaffected by BART service.
6) Impact shown is the greater of the A.M. and P.M. peak-hour impacts.
7) Full Alternative Names:
   Proposed Project – Locally Preferred Alternative (LPA)
   Alternative I – No Build Alternative
   Alternative II – Transportation Systems Management (TSM)
   Alternative III – BART to Airport Intermodal (Base Case)
   Alternative IV – Airport Aerial East of Highway 101 with I-380/San Bruno Station
   Alternative V – Minimum Length Subway to Millbrae Intermodal with I-380/San Bruno Station
   Design Option V-B – Minimum Length Subway to San Bruno with I-380/San Bruno Station
   Alternative VI – Millbrae Avenue via the Airport International Terminal

Table 5-13
2010 Cumulative CO Concentrations

	1993 Cumulative CO Impact (ppm)		2010 Cumulative CO Impact (ppm)															
	No Build		LPA		No Build		TSM		Base Case		Alt. IV		Alt. V		Des. Opt. V-B		Alt. VI	
Intersection	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour	1-hour	8-hour
El Camino Real/Hickey Boulevard	**20.1**	9.9	9.7	4.5	9.4	4.4	9.7	4.5	9.4	4.4	9.6	4.5	9.8	4.6	9.7	4.5	9.7	4.5
I-280 southbound ramps/Sneath Lane	13.6	6.1	7.3	3.1	7.3	3.1	7.3	3.1	7.3	3.1	7.3	3.1	7.3	3.1	7.2	3.1	7.3	3.1
Mission Road/Evergreen Drive	**18.6**	**9.0**	**8.0**	**3.5**	**8.8**	**4.0**	**8.9**	**4.1**	**8.8**	**4.0**	**8.0**	**3.5**	**8.0**	**3.5**	**8.0**	**3.5**	**8.0**	**3.5**
Mission Road/"new street"	NA	NA	8.2	3.6	NA	NA	NA	NA	NA	NA	8.2	3.6	8.2	3.6	8.2	3.6	8.2	3.6
El Camino Real/"new street"	**NA**	**NA**	**8.8**	**4.0**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**8.9**	**4.1**	**8.9**	**4.1**	**8.8**	**4.0**	**8.4**	**3.8**
Mission Road/Grand Avenue	20.0	9.9	9.0	4.1	9.1	4.2	9.2	4.2	9.3	4.3	8.9	4.1	8.9	4.1	9.0	4.1	8.8	4.0
Chestnut Avenue/Grand Avenue	**17.5**	**8.4**	**8.6**	**3.9**	**8.5**	**3.8**	**8.4**	**3.8**	**8.7**	**3.9**	**8.5**	**3.8**	**8.5**	**3.8**	**8.5**	**3.8**	**8.5**	**3.8**
Mission Road/Oak Avenue	11.2	4.7	6.7	2.8	6.8	2.8	6.8	2.8	9.0	4.1	6.7	2.8	6.8	2.8	6.7	2.8	6.7	2.8
El Camino Real/Arroyo Drive	**15.6**	**7.3**	**8.1**	**3.6**	**8.0**	**3.5**	**8.0**	**3.5**	**9.5**	**4.4**	**8.1**	**3.6**	**8.1**	**3.6**	**8.1**	**3.6**	**8.2**	**3.6**
Junipero Serra Boulevard/Westborough Blvd.	18.7	9.1	8.2	3.6	8.3	3.7	8.3	3.7	8.3	3.7	8.3	3.7	8.3	3.7	8.3	3.7	8.2	3.6
El Camino Real/Westborough Boulevard	**20.6**	**10.2**	**9.0**	**4.1**	**9.0**	**4.1**	**9.0**	**4.1**	**9.2**	**4.2**	**9.1**	**4.2**	**9.0**	**4.1**	**9.0**	**4.1**	**9.0**	**4.1**
El Camino Real/South Spruce Avenue	18.2	8.8	8.3	3.7	8.4	3.8	8.3	3.7	8.4	3.8	8.3	3.7	8.3	3.7	8.3	3.7	8.2	3.6
El Camino Real/Sneath Lane	**19.2**	**9.4**	**8.8**	**4.0**	**8.7**	**3.9**	**8.6**	**3.9**	**8.8**	**4.0**	**8.6**	**3.9**	**8.6**	**3.9**	**8.6**	**3.9**	**8.7**	**3.9**
Huntington Avenue/Sneath Lane	17.7	8.5	8.5	3.8	8.5	3.8	8.3	3.7	8.3	3.7	8.4	3.8	8.4	3.8	8.4	3.8	8.6	3.9
El Camino Real/San Bruno Avenue	**17.7**	**8.5**	**8.7**	**3.9**	**8.3**	**3.7**	**8.2**	**3.6**	**8.7**	**3.9**	**8.4**	**3.8**	**8.4**	**3.8**	**9.3**	**4.3**	**9.2**	**4.2**
San Mateo Avenue/San Bruno Avenue	17.9	8.6	8.5	3.8	8.6	3.9	8.6	3.9	8.5	3.8	9.4	4.4	9.4	4.4	9.4	4.4	8.7	3.9
2nd Avenue/San Bruno Avenue	**17.8**	**8.6**	**8.5**	**3.8**	**8.5**	**3.8**	**8.5**	**3.8**	**8.5**	**3.8**	**9.4**	**4.4**	**9.5**	**4.4**	**9.3**	**4.3**	**8.5**	**3.8**
San Mateo Avenue/Huntington Avenue	13.0	5.7	7.2	3.1	7.2	3.1	7.2	3.1	7.2	3.1	7.4	3.2	7.3	3.1	7.3	3.1	7.3	3.1
Huntington Avenue/Angus Avenue	**16.8**	**8.0**	**8.4**	**3.8**	**8.4**	**3.8**	**8.4**	**3.8**	**8.4**	**3.8**	**8.5**	**3.8**	**10.8**	**5.2**	**9.4**	**4.3**	**8.8**	**4.0**
El Camino Real/Center Street	18.6	9.0	8.5	3.8	8.5	3.8	8.6	3.9	8.9	4.1	9.4	4.4	9.6	4.5	8.5	3.8	8.7	3.9
El Camino Real/Millbrae Avenue	**16.1**	**7.6**	**7.8**	**3.4**	**7.8**	**3.4**	**7.8**	**3.4**	**7.8**	**3.4**	**7.7**	**3.3**	**7.7**	**3.3**	**7.8**	**3.4**	**8.0**	**3.5**
Rollins Road/Millbrae Avenue	18.4	8.9	ND	ND	8.3	3.7	8.5	3.8	ND	ND	ND	ND	ND	ND	ND	ND	8.4	3.8
El Camino Real/Murchison Drive	**16.7**	**7.9**	**ND**	**ND**	**7.8**	**3.4**	**7.8**	**3.4**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**8.0**	**3.5**
California Drive/Broadway	17.1	8.2	ND	ND	8.0	3.5	8.0	3.5	ND	ND	ND	ND	ND	ND	ND	ND	8.0	3.5

Notes:

1) Federal and State 8-hour standards are 9.0 ppm.
2) Federal 1-hour standard is 35 ppm; State 1-hour standard is 20 ppm.
3) 1993 1-hour background is 10.4 ppm; 1993 8-hour background is 4.2 ppm. 2010 1-hour background is 6.6 ppm; 1998 8-hour background is 2.7 ppm.
4) NA - Not applicable; intersection does not exist under this alternative.
5) ND - Not analyzed; traffic data were not provided for this alternative since intersection would be unaffected by BART service.
6) Impact shown is the greater of the A.M. and P.M. peak-hour impacts.
7) Full Alternative Names:
   Proposed Project – Locally Preferred Alternative (LPA)
   Alternative I – No Build Alternative
   Alternative II – Transportation Systems Management (TSM)
   Alternative III – BART to Airport Intermodal (Base Case)
   Alternative IV – Airport Aerial East of Highway 101 with I-380/San Bruno Station
   Alternative V – Minimum Length Subway to Millbrae Intermodal with I-380/San Bruno Station
   Design Option V-B – Minimum Length Subway to San Bruno with I-380/San Bruno Station
   Alternative VI – Millbrae Avenue via the Airport International Terminal

- the project must eliminate, or reduce the severity and number of, violations of the CO standard in the area substantially affected by the project; and

- the project must be consistent with the 1982 Plan.

The currently applicable EPA conformity criteria echo those in MTC Resolution No. 2270. The following are applicable EPA conformity requirements:

- The project must come from a conforming transportation plan and program (i.e., a TIP and RTP that have been found to conform); and

- The project must eliminate, or reduce the severity and number of, localized violations of the CO ambient air quality standard in the area substantially affected by the project. Microscale CO analysis must be completed using EPA-recommended air quality models and procedures.

The MTC, in conjunction with the federal Department of Transportation and the EPA, made a formal joint conformity determination for the current local TIP and RTP, and found that those documents conform to the 1982 Plan (MTC 1992). The proposed project is included in the TIP and RTP, and thus satisfies the first criterion.

Based on written policy positions included in MTC (1992c) and EPA (58 CFR 228) conformity language and/or guidance, if there are predicted exceedances of the CO air quality standards under the no-build scenario for a project and no predicted exceedances under the build scenario(s), then the project may be found to satisfy the second criterion of eliminating or reducing the number and severity of violations of the CO ambient air quality standard in the area substantially affected by the project. That project conformity criterion is common to the EPA and MTC requirements. The proposed project and all other BART build alternatives satisfy this criterion, based on the results of the microscale CO impact analysis completed for the project and presented above.

Lastly, this air quality impact analysis addresses the conformity assessment procedures required by the MTC for affected transportation projects. In conforming to the 1982 Plan, and in meeting the first two MTC conformity criteria, it is the position of BART that the project satisfies the MTC final applicable conformity criteria.

BART, the MTC, and the FTA will make the formal conformity determination for this project; therefore the criteria for the conformity determination itself are not germane to this discussion.

Table 5-14
1998 Microscale CO Analysis
BART Parking Areas

Alternative	Station	Composite Emission Factor (1) (g/veh exit)	PM Peak Hour Exit Volume (2) (veh/hr)	Worst Case One-hour Impact (3) (ppm)	Worst Case Eight-hour Impact (4) (ppm)
Proposed Project	Airport Intermodal	21.77	528	12.9	6.4
Alternative III - Base Case	Airport Intermodal	21.77	589	13.6	6.8
Alternative IV - Airport Aerial	I-380/San Bruno	20.83	420	10.6	5.1
Alternative V - Minimum Length Subway	I-380/San Bruno	20.28	368	10.0	4.7
Design Option V-B - Minimum Length Subway to San Bruno	Downtown San Bruno Intermodal Lot 1	12.99	372	8.5	3.8
Design Option V-B - Minimum Length Subway to San Bruno	Downtown San Bruno Intermodal Lot 2	12.14	372	(5)	(5)
Alternative VI - Millbrae Av. via SFO	Tanforan	49.55	721 (6)	15.4	7.5
Alternative VI - Millbrae Av. via SFO	Millbrae	22.89	277	8.9	4.1
Alternative VI - Millbrae Av. via SFO	Millbrae	22.07	648	(7)	(7)

Notes:

1) Composite emission factor derived from EMFAC7F, adjusted for fraction of incremental cold/hot starts occurring in lot.
2) Traffic volume is maximum vehicles exiting in the PM peak hour (PBQ&D).
3) Worst-case 1-hour impact includes 1998 background of 8.6 ppm from Table 3.10-3.
4) Worst-case 8-hour impact calculated with persistence factor of 0.59, or represents actual 8-hour average using hourly meteorological data; includes 1998 background of 3.5 ppm from Table 5-2.
5) Design Option V-B Downtown San Bruno Intermodal Station impact from both lots combined.
6) Alternative VI Tanforan Station exit volume consists of 142 kiss-and-ride vehicles/hour plus 579 vehicles/hour from BART/Tanforan Shopping Center Parking.
7) Alternative VI Millbrae Station impact from both lots combined.
8) No Build and TSM not analyzed. Available traffic data did not allow evaluation of other design options.

6. REFERENCES

American Association of State Highway and Transportation Officials (AASHTO). 1990. *Geometric Design of Highways and Streets.*

Bay Area Air Quality Management District (BAAQMD). 1985. *Air Quality and Urban Development: Guidelines for Assessing Impacts of Projects and Plans*. November.

BAAQMD. 1991. *Air Quality and Urban Development: Guidelines for Assessing Impacts of Projects and Plans.* Guidelines Update - Vehicle Emission Factors and Carbon Monoxide Maps. September 12.

BAAQMD. 1993a. *Air Quality and Urban Development Guidelines for Assessing Impacts of Projects and Plans* (Revised). Bay Area Air Quality Management District. June.

BAAQMD. 1993b. Personal communication between Joe Steinberger, BAAQMD, and Dana Byrne, Ogden Environmental and Energy Services Company Inc. August.

BAAQMD. 1994. Personal communication between Mike Kim, BAAQMD, and Carolyn Atwood, Ogden Environmental and Energy Services Company Inc.

Bay Area Rapid Transit (BART). 1993. Letter from Joan Kugler of BART to D. Eisinger of the EPA Region IX, dated September 17, 1993.. Includes return concurrence signature from V. Petrites of the MTC dated 12 October, 1993.

BART. 1994a. Letter from Joan Kugler of BART to D. Eisinger of the EPA Region IX, dated May 20.

BART. 1994b. Letter from Joan Kugler of BART to D. Eisinger of the EPA Region IX, dated June 24.

Bay Area Traffic Consultants (BATC). 1993a and 1994a. *Preliminary Construction Scenario Report: Appendix F* (1993a). Updated for Alternative VI (1994a). Prepared for BART for the BART-SFO Extension Project.

BATC. 1993b and 1994b. Preliminary BART Station Plans and Elevations (1993b), including supplementary parking area revisions (5 May versions). Updated for Alternative VI (1994b). Prepared for BART for the BART-SFO Extension Project.

Baymetrics Traffic Resources (Baymetrics). 1993. *BART-SFO Expansion EIR Lane Geometry and Signal Phasing: Technical Appendix A.* Submitted to Parsons Brinkerhoff Quade & Douglas. October.

Benson, Paul E. 1991. *Using CALINE4 to Estimate Air Quality Impacts Near Intersections.*

Bonneson, James A. 1992. *Modeling Queued Driver Behavior at Signalized Junctions.* Transportation Research Board. Transportation Research Record No. 1365.

California Environmental Protection Agency Air Resources Board (CARB). 1988, 1989a, 1990, 1991, 1992, 1993d). *Annual Summary California Air Quality Data.*

CARB. 1993a. EMFAC7F Version 1.0. Released August 23.

CARB. 1993b. *Methodology for Estimating Emissions from On-Road Motor Vehicles Volume I: EMFAC7F.*

CARB. 1993c. *Ozone Planning Inventory* reports for San Mateo County, calendar years 1993, 1998, 2000, and 2010.

CARB. 1993e. Personal communication between Nathaniel Kong of CARB and Gregory Noblet of Ogden Environmental and Energy Services Company Inc. November 30.

CARB. 1993e. Personal communication between Tom Lusk of CARB and Dana Byrne of Ogden Environmental and Energy Services Company Inc. August.

CARB. 1994. Personal communication between Fred Medina of CARB and Gregory Noblet of Ogden Environmental and Energy Services Company Inc. April.

State of California Department of Transportation (Caltrans). 1989a. *Air Quality Technical Analysis Notes.* June.

Caltrans. 1989b. *CALINE4 – A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways.* Final Report Nov. 2. 1984, Revised June 1989. Report No. FHWA/CA/TL-84/15.

Caltrans. 1989c. *CALINE4.* June 1989 Version.

United States Environmental Protection Agency (EPA). 1985. *Compilation of Air Pollutant Emission Factors AP-42: Volume II.* September.

EPA. 1991. *Non-Road Engine and Vehicle Emission Study.*

EPA. 1992a. *Guideline for Modeling Carbon Monoxide from Roadway Intersections.* November.

EPA. 1992b. *User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections.* Office of Air Quality Planning and Standards. Technical Support Division. November, 1992. Report No. EPA-454/R-92-006.

EPA. 1993a. Air Quality Modeling Guidance for PM-10 Roadway Emissions. United States Environmental Protection Agency.

EPA. 1993b. Determining Conformity of General Federal Actions to State or Federal Implementation Plans. 40 CFR Parts 6, 51, and 93. November.

EPA. 1993c. 58 FR 62212 (K): preamble to the final conformity rule. November.

EPA. 1993d. 40 CFR 93 - *Determining Conformity of Federal Actions to State of Federal Implementation Plans,* subpart A - *Conformity to State of Federal Implementation Plans of Transportation Plans, Programs, or Projects Developed, Funded, or Approved under Title 23 USC or the Federal Transit Act.* November 30.

EPA. 1993e. *Air Quality Modeling Guidance for PM-10 Roadway Emissions.* Draft. Office of Air Quality Planning and Standards.

EPA. 1994a. Letter from Douglas Eisinger, Chief of Mobil Sources Division at United States EPA Region IX, to Michael H. Scheible, Deputy Executive Officer of California Air Resources Board. Notification of EPA approval of EMFAC7F Version 1.1. May 3.

EPA. 1994b. EPA-validated SFIA meteorological data files available from EPA electronic bulletin board, Research Triangle Park, NC. Downloaded January.

Federal Transit Administration (FTA). 1985. *Highway Capacity Manual.*

FTA. 1993a. *Highway Capacity Manual.* Draft Version.

FTA. 1993b. Personal communication between O'Laughlin of FTA and Carolyn Atwood of Ogden Environmental and Energy Services Company Inc.

Korve Engineering (Korve). 1994a. Written description of coordinated traffic signal systems within the BART project area.

Korve. 1994b. Table identifying vehicle arrival type at traffic intersections selected for local CO impacts analysis.

Korve. 1994c. Facsimilie transmittal verifying the lack of site-specific data regarding vehicle thermal operating states.

Korve. 1994d. Personal communication between Madhu Konda of Korve and Gregory Noblet of Ogden Environmental and Energy Services Company Inc. April.

Metropolitan Transportation Commission (MTC). 1991a. Resolution No. 2270. April 24.

MTC. 1991b. *Project Sponsor Guidance and Checklist for Carbon Monoxide Analysis Performed for Conformity Assessment of Transportation Projects.* Bay Area Metropolitan Transportation Commission.

MTC. 1991c. Resolution Nos. 2333 and 2339: MTC findings of conformity for the RTP and TIP in relation to the 1982 Plan. Made in conjuction with EPA and the U.S. Department of Transportation. November 14.

MTC. 1993a. *Transportation Improvement Program for the Nine-county San Francisco Bay Area 1994 Volume III, Part A: ISTEA Flexible Funds Surface Transportation Program and Congestion Mitigation and Air Quality Program.*

MTC. 1993b. *Transportation Improvement Program for the Nine-county San Francisco Bay Area 1994 Volume III, Part B: Air Quality Assessment.*

MTC. 1993c. Personal communication between Susan Pultz of the MTC and Dana Byrne of Ogden Environmental and Energy Services Company Inc. August.

MTC. 1993d. Personal communication between Douglas Kimsey of the MTC and Carolyn Atwood of Ogden Environmental and Energy Services Company Inc. August.

MTC. 1993e. Personal communication between Michael King of MTC and Carolyn Atwood of Ogden Environmental and Energy Services Company Inc. August.

MTC. 1993f. Memorandum from Miguel Iglesias MTC and Gregory Noblet of Ogden Environmental and Energy Services Company Inc. October 18.

MTC. 1994 Telephone Conversation. January 30.

City of Millbrae (1993). Plan views and profiles of selected traffic intersections within the City of Millbrae.

Ogden Environmental and Energy Services Co., Inc. (Ogden). 1993. *Air Quality Impact Analysis Protocol for the DEIR/DEIS on the Proposed BART–SFO Extension Project.* September.

Ogden. 1994. *Air Quality Impact Analysis Protocol – Evaluation of Localized CO Impacts for the BART–San Francisco Airport Extension Project.* May.

Pacific Aerial Surveys. (1993). 1993 aerial photographs of selected intersections within the BART project area. Scale 1"=100'.

Parsons Brinckerhoff Quade & Douglas (PBQ&D). 1994a. *Signalized Intersection Worksheet, Critical Movement Analysis: Planning Calculation Form 1.*

PBQ&D. 1994b. Unsignalized Intersection Worksheets.

PBQ&D. 1994c. *All-Way Stop Intersection--Level of Service Analysis* worksheets.

PBQ&D. 1994d. Personal communication between Ross Maxwell of PBQ&D and Gregory Noblet of Ogden Environmental and Energy Services Co., Inc. April.

City of San Bruno (1993). Plan views and profiles of selected traffic intersections within the City of San Bruno.

South Coast Air Quality Management District (SCAQMD). 1993. *CEQA Air Quality Handbook.*

Attachment A
Construction Fleet Data

Attachment 3-A - Construction Equipment Emissions Backup Data

BATC Appendix Reference	Alternative
Appendix F-1	Proposed Project-Locally Perferred Alternative
Appendix F-2	I-380 Least-Cost Design Option
NA	Alternative I- No Project
NA	Alternative II-Transportation System Management
Appendix F-3	Alternative III-BART to Airport Intermodal (Base Case)
Appendix F-4	Alternative IV-Airport Aerial East of Highway 101
Appendix F-5	Alternative IV-Airport Aerial East of Highway 101 With San Bruno Aerial Station
Appendix F-6	Alternative V-Minimum Length Subway to Millbrae
Appendix F-7	Alternative V-Minimum Length(w/I-380 Station)
Appendix F-8	Alternative V-Minimum Length(w/downtown Station)
Appendix F-9	Alternative V-a Minimum Length Subway to Airport
Appendix F-10	Alternative V-a Minimum Length to Airport(w/I-380)
Appendix F-11	Alternative V-b Minimum Length Subway to San Bruno
Appendix F-12	Alternative V-b (with Downtown San Bruno)

EQUIPMENT TYPE	# USED	RATED H.P.	HOURS	LOAD FACTOR	CARBON MONOXIDE EMISSION FACTOR	CARBON MONOXIDE EMISSION RATE lbs	EXHAUST ROG EMISSION FACTOR	EXHAUST ROG EMISSION RATE lbs	NITROGEN OXIDES EMISSION FACTOR	NITROGEN OXIDES EMISSION RATE lbs	SULFUR OXIDES EMISSION FACTOR	SULFUR OXIDES EMISSION RATE lbs	PARTICULATES EMISSION FACTOR	PARTICULATES EMISSION RATE lbs
[illegible]	1	356	3313	0.59	0.01	2758	0.002	552	0.021	5791	0.002	552	0.0005	[illegible]
MOTOR GRADER	1	1	3313	1	0.151	198	0.039	51	0.713	936	0.086	113	0.061	80
SCRAPER	1	1	3313	1	1.25	1641	0.27	355	3.84	5042	0.46	604	0.41	[illegible]
DUMP TRK	5	1	3313	1	0.675	4431	0.15	985	1.7	11161	0.143	939	0.14	[illegible]
PWR SHOVEL	1	79	3961	0.465	0.015	2183	0.003	437	0.022	3201	0.002	291	0.001	146
WATER TRK	1	1	3961	1	0.675	2674	0.15	594	1.7	6734	0.143	566	0.14	555
PICKUP	1	1	3961	1	0.016	63	0.0017	7	0.0017	[illegible]	0.0001	0	0.0003	[illegible]
DUMP TRK	24	1	3961	1	0.675	64168	0.15	14260	1.7	161609	0.143	13594	0.14	[illegible]
ROLLER	1	1	833	1	0.3	250	0.065	54	0.87	725	0.067	56	0.05	42
MOTOR GRADER	1	1	833	1	0.151	126	0.039	32	0.713	594	0.086	72	0.061	51
WATER TRK	1	1	416	1	0.675	281	0.15	62	1.7	707	0.143	59	0.14	58
TUNNEL MACH	1	450	560	0.695	0.02	3503	0.003	525	0.022	3853	0.002	350	0.0015	[illegible]
CONVEYOR	1	450	560	0.695	0.02	3503	0.003	525	0.022	3853	0.002	350	0.0015	[illegible]
VENTILATOR	1	22	560	0.74	0.011	100	0.002	18	0.018	164	0.002	18	0.001	9
JACKS	1	1	560	1	0.675	378	0.15	84	1.7	952	0.143	80	0.14	78
CRANE	1	194	560	0.43	0.009	420	0.003	140	0.023	1074	0.002	93	0.0015	70
GENERATOR	1	22	560	0.74	0.011	100	0.002	18	0.018	164	0.002	18	0.001	9
DRILL RIG	1	209	945	0.75	0.02	2963	0.003	444	0.024	3555	0.002	296	0.0015	[illegible]
TANK TRK	1	1	945	1	0.675	638	0.15	142	1.7	1607	0.143	135	0.14	132
PUMP	1	22	945	0.74	0.011	169	0.002	31	0.018	277	0.002	31	0.001	15
CRANE	1	194	11011	0.43	0.009	8267	0.003	2756	0.023	21126	0.002	1837	0.0015	1378
CONCRETE TRK.	4	1	11011	1	0.675	29730	0.15	6607	1.7	74875	0.143	6298	0.14	6166
CONCRETE PUMP	1	23	11011	0.74	0.011	2061	0.002	375	0.018	3373	0.002	375	0.001	187
PICKUP	1	0	11011	0	0.016	0	0.0017	0	0.0017	0	0.0001	0	0.0003	0
CRANE	2	194	107	0.43	0.009	161	0.003	54	0.023	411	0.002	36	0.0015	27
SPECIAL TRK	1	161	107	0.62	0.02	214	0.003	32	0.024	256	0.002	21	0.0015	16
PWR TOOLS	1	5	1612	1	0	0	0	0	0	0	0	0	0	0
PWR TOOLS	1	5	1251	1	0	0	0	0	0	0	0	0	0	0
PILE HMR	1	43	6220	0.505	0.013	1756	0.003	405	0.031	4187	0.002	270	0.0015	203
CRANE	1	194	6220	0.43	0.009	4670	0.003	1557	0.023	11934	0.002	1038	0.0015	778
AIR COMPRES	1	37	6220	0.48	0.011	1215	0.002	221	0.018	1988	0.002	221	0.001	110
FRK LFT 175HP	1	1	6220	1	0.52	3234	0.17	1057	1.54	9579	0	0	0.093	578
PICKUP	1	1	2354	1	0.016	38	0.0017	4	0.0017	4	0.0001	0	0.0003	1
BACKHOE	1	79	2354	0.465	0.015	1297	0.003	259	0.022	1902	0.002	173	0.001	86
DUMP TRK.	1	1	2354	1	0.675	1589	0.15	353	1.7	4002	0.143	337	0.14	330
PICKUP	1	1	238	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
WELDER	1	35	238	0.45	0.011	41	0.002	7	0.018	67	0.002	7	0.001	4
PICKUP	1	1	834	1	0.016	13	0.0017	1	0.0017	1	0.0001	0	0.0003	0
MOTOR GRADER	3	1	411	1	0.151	186	0.039	48	0.713	879	0.086	106	0.061	75
PAVER	1	130	411	0.62	0.01	331	0.002	66	0.022	729	0.002	66	0.001	33
ROLLERS	5	1	411	1	0.3	617	0.065	134	0.87	1788	0.067	138	0.05	103
DUMP TRK.	21	1	411	1	0.675	5826	0.15	1295	1.7	14673	0.143	1234	0.14	1208
MOTOR GRADER	1	1	1372	1	0.151	207	0.039	54	0.713	978	0.086	118	0.061	84
LOADER	1	1	1372	1	0.572	785	0.23	316	1.9	2607	0.182	250	0.17	233
DUMP TRK.	4	1	1372	1	0.675	3704	0.15	823	1.7	9330	0.143	785	0.14	768
PICKUP	1	1	127	1	0.016	2	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	127	1	1.25	159	0.27	34	3.84	488	0.46	58	0.41	52
LOADER	1	1	127	1	0.572	73	0.23	29	1.9	241	0.182	23	0.17	22
ROLLERS	1	1	127	1	0.3	38	0.065	8	0.87	110	0.067	9	0.05	6
DUMP TRK.	14	1	127	1	0.675	1200	0.15	267	1.7	3023	0.143	254	0.14	249
PICKUP	1	1	254	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	254	1	1.25	318	0.27	69	3.84	975	0.46	117	0.41	104
LOADER	1	1	254	1	0.572	145	0.23	58	1.9	483	0.182	46	0.17	43
BALLAST PROF.	1	1	254	1	1.25	318	0.27	69	3.84	975	0.46	117	0.41	104
DUMP TRK	14	1	254	1	0.675	2400	0.15	533	1.7	6045	0.143	509	0.14	498
PICKUP	1	1	239	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
BACKHOE	1	79	239	0.465	0.015	132	0.003	26	0.022	193	0.002	18	0.001	9
LOADER	1	1	1711	1	0.572	979	0.23	394	1.9	3251	0.182	311	0.17	291
TRACK. WELD.	1	35	1711	0.45	0.011	296	0.002	54	0.018	485	0.002	54	0.001	27
LOADER	1	1	1619	1	0.572	926	0.23	372	1.9	3076	0.182	295	0.17	275

WELDER	1	35	1619	0.45	0.011	280	0.002	51	0.018	459	0.002	51	0.001	26
PICKUP	1	1	1619	1	0.016	26	0.0017	3	0.0017	3	0.0001	0	0.0003	0
LOADER	1	1	5424	1	0.572	3103	0.23	1248	1.9	10306	0.182	987	0.17	922
BACKHOE	1	79	5418	0.465	0.015	2985	0.003	597	0.022	4379	0.002	398	0.001	199
DUMP TRK	2	1	5418	1	0.675	7314	0.15	1625	1.7	18421	0.143	1550	0.14	1517
PICKUP	1	1	5418	1	0.016	87	0.0017	9	0.0017	9	0.0001	1	0.0003	2

EQUIPMENT APP. V-2	# USED	RATED H.P.	HOURS	LOAD FACTOR	CARBON MONOXIDE EMISSION FACTOR	CARBON MONOXIDE EMISSION RATE lbs	EXHAUST ROG EMISSION FACTOR	EXHAUST ROG EMISSION RATE lbs	NITROGEN OXIDE EMISSION FACTOR	NITROGEN OXIDE EMISSION RATE lbs	SULFUR OXIDES EMISSION FACTOR	SULFUR OXIDES EMISSION RATE lbs	PARTICULATES EMISSION FACTOR	PARTICULATES EMISSION RATE lbs
BULLDOZER	1	356	1226	0.59	0.01	2575	0.002	515	0.021	5408	0.002	515	0.0005	129
MOTOR GRADER	1	1	1226	1	0.151	185	0.039	48	0.713	874	0.086	105	0.061	75
SCRAPER	1	1	1226	1	1.25	1533	0.27	331	3.84	4708	0.46	564	0.41	503
DUMP TRK	5	1	1226	1	0.675	4138	0.15	920	1.7	10421	0.143	877	0.14	858
PWR. SHOVEL	1	79	3221	0.465	0.015	1775	0.003	355	0.022	2603	0.002	237	0.001	118
WATER TRK	1	1	3221	1	0.675	2174	0.15	483	1.7	5476	0.143	461	0.14	451
PICKUP	1	1	3221	1	0.016	52	0.0017	5	0.0017	5	0.0001	0	0.0003	1
DUMP TRK	24	1	3221	1	0.675	52180	0.15	11596	1.7	131417	0.143	11054	0.14	10823
ROLLER	1	1	688	1	0.3	206	0.065	45	0.87	599	0.067	46	0.05	34
MOTOR GRADER	1	1	688	1	0.151	104	0.039	27	0.713	491	0.086	59	0.061	42
WATER TRK	1	1	344	1	0.675	232	0.15	52	1.7	585	0.143	49	0.14	48
TUNNEL MACH	1	450	560	0.695	0.02	3503	0.003	525	0.022	3853	0.002	350	0.0015	263
CONVEYOR	1	450	560	0.695	0.02	3503	0.003	525	0.022	3853	0.002	350	0.0015	263
VENTILATOR	1	22	560	0.74	0.011	100	0.002	18	0.018	164	0.002	18	0.001	9
JACKS	1	1	560	1	0.675	378	0.15	84	1.7	952	0.143	80	0.14	78
CRANE	1	194	560	0.43	0.009	420	0.003	140	0.023	1074	0.002	93	0.0015	70
GENERATOR	1	22	560	0.74	0.011	100	0.002	18	0.018	164	0.002	18	0.001	9
DRILL RIG	1	209	5452	0.75	0.02	17092	0.003	2564	0.024	20510	0.002	1709	0.0015	1282
TANK TRK	1	1	5452	1	0.675	3680	0.15	818	1.7	9268	0.143	780	0.14	763
PUMP	1	22	5452	0.74	0.011	976	0.002	178	0.018	1598	0.002	178	0.001	89
CRANE	1	194	9448	0.43	0.009	7093	0.003	2364	0.023	18127	0.002	1576	0.0015	1182
CONCRETE TRK.	4	1	9448	1	0.675	25510	0.15	5669	1.7	64246	0.143	5404	0.14	5291
CONCRETE PUMP	1	23	9448	0.74	0.011	1769	0.002	322	0.018	2894	0.002	322	0.001	161
PICKUP	1	0	9448	0	0.016	0	0.0017	0	0.0017	0	0.0001	0	0.0003	0
CRANE	2	194	616	0.43	0.009	925	0.003	308	0.023	2364	0.002	206	0.0015	154
SPECIAL TRK.	1	161	616	0.62	0.02	1230	0.003	184	0.024	1476	0.002	123	0.0015	92
PWR. TOOLS	1	5	1612	1	0	0	0	0	0	0	0	0	0	0
PWR TOOLS	1	5	1907	1	0	0	0	0	0	0	0	0	0	0
PILE HMR.	1	43	4936	0.505	0.013	1393	0.003	322	0.031	3323	0.002	214	0.0015	161
CRANE	1	194	4936	0.43	0.009	3706	0.003	1235	0.023	9471	0.002	824	0.0015	618
AIR COMPRES.	1	37	4936	0.48	0.011	964	0.002	175	0.018	1578	0.002	175	0.001	88
FRK.LFT.175HP	1	1	4936	1	0.52	2567	0.17	839	1.54	7601	0	0	0.093	459
PICKUP	1	1	2050	1	0.016	33	0.0017	3	0.0017	3	0.0001	0	0.0003	1
BACKHOE	1	79	2050	0.465	0.015	1130	0.003	226	0.022	1657	0.002	151	0.001	75
DUMP TRK.	1	1	2050	1	0.675	1384	0.15	308	1.7	3485	0.143	293	0.14	287
PICKUP	1	1	310	1	0.016	5	0.0017	1	0.0017	1	0.0001	0	0.0003	0
WELDER	1	35	310	0.45	0.011	54	0.002	10	0.018	88	0.002	10	0.001	5
PICKUP	1	1	1058	1	0.016	17	0.0017	2	0.0017	2	0.0001	0	0.0003	0
MOTOR GRADER	3	1	420	1	0.151	190	0.039	49	0.713	898	0.086	108	0.061	77
PAVER	1	130	420	0.62	0.01	339	0.002	68	0.022	745	0.002	68	0.001	34
ROLLERS	5	1	420	1	0.3	630	0.065	137	0.87	1827	0.067	141	0.05	105
DUMP TRK.	21	1	420	1	0.675	5954	0.15	1323	1.7	14994	0.143	1261	0.14	1235
MOTOR GRADER	1	1	1395	1	0.151	211	0.039	54	0.713	995	0.086	120	0.061	85
LOADER	1	1	1395	1	0.572	798	0.23	321	1.9	2651	0.182	254	0.17	237
DUMP TRK.	4	1	1395	1	0.675	3767	0.15	837	1.7	9486	0.143	798	0.14	781
PICKUP	1	1	159	1	0.016	3	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	159	1	1.25	199	0.27	43	3.84	611	0.46	73	0.41	65
LOADER	1	1	159	1	0.572	91	0.23	37	1.9	302	0.182	29	0.17	27
ROLLER	1	1	159	1	0.3	48	0.065	10	0.87	138	0.067	11	0.05	8
DUMP TRK.	14	1	159	1	0.675	1503	0.15	334	1.7	3784	0.143	318	0.14	312
PICKUP	1	1	319	1	0.016	5	0.0017	1	0.0017	1	0.0001	0	0.0003	0
TAMPER LINER	1	1	319	1	1.25	399	0.27	86	3.84	1225	0.46	147	0.41	131
LOADER	1	1	319	1	0.572	182	0.23	73	1.9	606	0.182	58	0.17	54
BALLAST PROF.	1	1	319	1	1.25	399	0.27	86	3.84	1225	0.46	147	0.41	131
DUMP TRK	14	1	319	1	0.675	3015	0.15	670	1.7	7592	0.143	639	0.14	625
PICKUP	1	1	315	1	0.016	5	0.0017	1	0.0017	1	0.0001	0	0.0003	0
BACKHOE	1	79	315	0.465	0.015	174	0.003	35	0.022	255	0.002	23	0.001	12
LOADER	1	1	1754	1	0.572	1003	0.23	403	1.9	3333	0.182	319	0.17	298
TRACK. WELD.	1	35	1754	0.45	0.011	304	0.002	55	0.018	497	0.002	55	0.001	28
LOADER	1	1	1616	1	0.572	924	0.23	372	1.9	3070	0.182	294	0.17	275

WELDER	1	35	1616	0.45	0.011	280	0.002	51	0.018	458	0.002	51	0.001	25
PICKUP	1	1	1616	1	0.016	26	0.0017	3	0.0017	3	0.0001	0	0.0003	0
LOADER	1	1	5416	1	0.572	3098	0.23	1246	1.9	10290	0.182	986	0.17	921
BACKHOE	1	79	5095	0.465	0.015	2807	0.003	561	0.022	4118	0.002	374	0.001	187
DUMP TRK	2	1	5095	1	0.675	6878	0.15	1529	1.7	17323	0.143	1457	0.14	1427
PICKUP	1	1	5095	1	0.016	82	0.0017	9	0.0017	9	0.0001	1	0.0003	2
				Total		175996		39606.47		406774.4		34573.83		31562.54

EQUIPMENT APP. F-1	# USED	RATED H.P.	HOURS	LOAD FACTOR	CARBON MONOXIDE EMISSION FACTOR	CARBON MONOXIDE EMISSION RATE lbs	EXHAUST ROC EMISSION FACTOR	EXHAUST ROC EMISSION RATE lbs	NITROGEN OXIDES EMISSION FACTOR	NITROGEN OXIDES EMISSION RATE lbs	SULFUR OXIDES EMISSION FACTOR	SULFUR OXIDES EMISSION RATE lbs	PARTICULATE EMISSION FACTOR	PARTICULATE EMISSION RATE lbs
BULLDOZER	1	156	1214	0.59	0.01	2550	0.002	510	0.021	5355	0.002	510	0.0005	127
MOTOR GRADER	1	1	1214	1	0.151	183	0.039	47	0.713	866	0.086	104	0.061	74
SCRAPER	1	1	1214	1	1.25	1518	0.27	328	3.84	4662	0.46	558	0.41	498
DUMP TRK	5	1	1214	1	0.675	4097	0.15	911	1.7	10319	0.143	868	0.14	850
PWR. SHOVEL	1	79	2426	0.465	0.015	1337	0.003	267	0.022	1961	0.002	178	0.001	89
WATER TRK	1	1	2426	1	0.675	1638	0.15	364	1.7	4124	0.143	347	0.14	340
PICKUP	1	1	2426	1	0.016	39	0.0017	4	0.0017	4	0.0001	0	0.0003	1
DUMP TRK	24	1	2426	1	0.675	39301	0.15	8734	1.7	98981	0.143	8326	0.14	8151
ROLLER	1	1	566	1	0.3	170	0.065	37	0.87	492	0.067	38	0.05	28
MOTOR GRADER	1	1	566	1	0.151	85	0.039	22	0.713	404	0.086	49	0.061	35
WATER TRK	1	1	283	1	0.675	191	0.15	42	1.7	481	0.143	40	0.14	40
TUNNEL MACH	1	450	560	0.695	0.02	3503	0.003	525	0.022	3853	0.002	350	0.0015	263
CONVEYOR	1	450	560	0.695	0.02	3503	0.003	525	0.022	3853	0.002	350	0.0015	263
VENTILATOR	1	22	560	0.74	0.011	100	0.002	18	0.018	164	0.002	18	0.001	9
JACKS	1	1	560	1	0.675	378	0.15	84	1.7	952	0.143	80	0.14	78
CRANE	1	194	560	0.43	0.009	420	0.003	140	0.023	1074	0.002	93	0.0015	70
GENERATOR	1	22	560	0.74	0.011	100	0.002	18	0.018	164	0.002	18	0.001	9
DRILL RIG	1	209	4990	0.75	0.02	15644	0.003	2347	0.024	18772	0.002	1564	0.0015	1173
TANK TRK.	1	1	4990	1	0.675	3368	0.15	749	1.7	8483	0.143	714	0.14	699
PUMP	1	22	4990	0.74	0.011	894	0.002	162	0.018	1462	0.002	162	0.001	81
CRANE	1	194	9073	0.43	0.009	6812	0.003	2271	0.023	17408	0.002	1514	0.0015	1135
CONCRETE TRK.	4	1	9073	1	0.675	24497	0.15	5444	1.7	61696	0.143	5190	0.14	5081
CONCRETE PUMP	1	23	9073	0.74	0.011	1699	0.002	309	0.018	2780	0.002	309	0.001	154
PICKUP	1	1	9073	1	0.016	145	0.0017	15	0.0017	15	0.0001	1	0.0003	3
CRANE	2	194	564	0.43	0.009	847	0.003	282	0.023	2164	0.002	188	0.0015	141
SPECIAL TRK.	1	161	564	0.62	0.02	1126	0.003	169	0.024	1351	0.002	113	0.0015	84
PWR. TOOLS	1	5	1691	1	0	0	0	0	0	0	0	0	0	0
PWR. TOOLS	1	5	1612	1	0	0	0	0	0	0	0	0	0	0
PILE HMR.	1	43	3876	0.505	0.013	1094	0.003	253	0.031	2609	0.002	168	0.0015	126
CRANE	1	194	3876	0.43	0.009	2910	0.003	970	0.023	7437	0.002	647	0.0015	485
AIR COMPRES.	1	37	3876	0.48	0.011	757	0.002	138	0.018	1239	0.002	138	0.001	69
FRK.LFT.175HP	1	1	3876	1	0.52	2016	0.17	659	1.54	5969	0	0	0.093	360
PICKUP	1	1	1462	1	0.016	23	0.0017	2	0.0017	2	0.0001	0	0.0003	0
BACKHOE	1	79	1462	0.465	0.015	806	0.003	161	0.022	1182	0.002	107	0.001	54
DUMP TRK.	1	1	1462	1	0.675	987	0.15	219	1.7	2485	0.143	209	0.14	205
PICKUP	1	1	1479	1	0.016	24	0.0017	3	0.0017	3	0.0001	0	0.0003	0
WELDER	1	35	1479	0.45	0.011	256	0.002	47	0.018	419	0.002	47	0.001	23
PICKUP	1	1	2148	1	0.016	34	0.0017	4	0.0017	4	0.0001	0	0.0003	1
MOTOR GRADER	3	1	592	1	0.151	268	0.039	69	0.713	1266	0.086	153	0.061	108
PAVER	1	130	592	0.62	0.01	477	0.002	95	0.022	1050	0.002	95	0.001	48
ROLLERS	5	1	592	1	0.3	888	0.065	192	0.87	2575	0.067	198	0.05	148
DUMP TRK.	21	1	592	1	0.675	8392	0.15	1865	1.7	21134	0.143	1778	0.14	1740
MOTOR GRADER	1	1	3314	1	0.151	500	0.039	129	0.713	2363	0.086	285	0.061	202
LOADER	1	1	3314	1	0.572	1896	0.23	762	1.9	6297	0.182	603	0.17	563
DUMP TRK.	4	1	3314	1	0.675	8948	0.15	1988	1.7	22535	0.143	1896	0.14	1856
PICKUP	1	1	401	1	0.016	6	0.0017	1	0.0017	1	0.0001	0	0.0003	0
TAMPER LINER	1	1	401	1	1.25	501	0.27	108	3.84	1540	0.46	184	0.41	164
LOADER	1	1	401	1	0.572	229	0.23	92	1.9	762	0.182	73	0.17	68
ROLLER	1	1	401	1	0.3	120	0.065	26	0.87	349	0.067	27	0.05	20
DUMP TRK.	14	1	401	1	0.675	3789	0.15	842	1.7	9544	0.143	803	0.14	786
PICKUP	1	1	802	1	0.016	13	0.0017	1	0.0017	1	0.0001	0	0.0003	0
TAMPER LINER	1	1	802	1	1.25	1003	0.27	217	3.84	3080	0.46	369	0.41	329
LOADER	1	1	802	1	0.572	459	0.23	184	1.9	1524	0.182	146	0.17	136
BALLAST PROF.	1	1	802	1	1.25	1003	0.27	217	3.84	3080	0.46	369	0.41	329
DUMP TRK	14	1	802	1	0.675	7579	0.15	1684	1.7	19088	0.143	1606	0.14	1572
PICKUP	1	1	880	1	0.016	14	0.0017	1	0.0017	1	0.0001	0	0.0003	0
BACKHOE	1	79	880	0.465	0.015	485	0.003	97	0.022	711	0.002	65	0.001	32
LOADER	1	1	1707	1	0.572	976	0.23	393	1.9	3243	0.182	311	0.17	290
TRACK. WELD.	1	35	1707	0.45	0.011	296	0.002	54	0.018	484	0.002	54	0.001	27
LOADER	1	1	1593	1	0.572	911	0.23	366	1.9	3027	0.182	290	0.17	271

WELDER	1	35	1593	0.45	0.011	276	0.002	50	0.018	452	0.002	50	0.001	25
PICKUP	1	1	1593	1	0.016	25	0.0017	3	0.0017	3	0.0001	0	0.0003	0
LOADER	1	1	5540	1	0.572	3169	0.23	1274	1.9	10526	0.182	1008	0.17	942
BACKHOE	1	79	5047	0.465	0.015	2781	0.003	556	0.022	4079	0.002	371	0.001	185
DUMP TRK	2	1	5047	1	0.675	6813	0.15	1514	1.7	17160	0.143	1443	0.14	1413
PICKUP	1	1	5047	1	0.016	81	0.0017	9	0.0017	9	0.0001	1	0.0003	2
				total		174950.3		39570.93		409071.8		35177.72		32058.99

EQUIPMENT APP F-4	# USED	RATED H P	HOURS	LOAD FACTOR	CARBON MONOXIDE EMISSION FACTOR	CARBON MONOXIDE EMISSION RATE lbs	EXHAUST ROC EMISSION FACTOR	EXHAUST ROC EMISSION RATE lbs	NITROGEN OXIDES EMISSION FACTOR	NITROGEN OXIDES EMISSION RATE lbs	SULFUR OXIDES EMISSION FACTOR	SULFUR OXIDES EMISSION RATE lbs	PARTICULATES EMISSION FACTOR	PARTICULATES EMISSION RATE lbs
BULLDOZER	1	356	1514	0.59	0.01	3180	0.002	636	0.021	6678	0.002	636	0.0005	159
MOTOR GRADER	1	1	1514	1	0.151	229	0.039	59	0.713	1079	0.086	130	0.061	92
SCRAPER	1	1	1514	1	1.25	1893	0.27	409	3.84	5814	0.46	696	0.41	621
DUMP TRK	5	1	1514	1	0.675	5110	0.15	1136	1.7	12869	0.143	1083	0.14	1060
PWR [illegible]	1	79	3862	0.465	0.015	2128	0.003	426	0.022	[illegible]	0.002	284	0.001	142
WATER TRK	1	1	3862	1	0.675	2607	0.15	579	1.7	6565	0.143	552	0.14	541
PICKUP	1	1	3862	1	0.016	62	0.0017	7	0.0017	7	0.0001	0	0.0003	1
DUMP TRK	24	1	3862	1	0.675	62564	0.15	13903	1.7	157570	0.143	13254	0.14	12976
ROLLER	1	1	659	1	0.3	198	0.065	43	0.87	573	0.067	44	0.05	33
MOTOR GRADER	1	1	659	1	0.151	100	0.039	26	0.713	470	0.086	57	0.061	40
WATER TRK	1	1	329	1	0.675	222	0.15	49	1.7	559	0.143	47	0.14	46
TUNNEL MACH.	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
CONVEYOR	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
VENTILATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
JACKS	1	1	0	1	0.675	0	0.15	0	1.7	0	0.143	0	0.14	0
CRANE	1	194	0	0.43	0.009	0	0.003	0	0.023	0	0.002	0	0.0015	0
GENERATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
DRILL RIG	1	209	9315	0.75	0.02	29203	0.003	4380	0.024	35043	0.002	2920	0.0015	2190
TANK TRK	1	1	9315	1	0.675	6288	0.15	1397	1.7	15836	0.143	1332	0.14	1304
PUMP	1	22	9315	0.74	0.011	1668	0.002	303	0.018	2730	0.002	303	0.001	152
CRANE	1	194	10592	0.43	0.009	7952	0.003	2651	0.023	20322	0.002	1767	0.0015	1325
CONCRETE TRK	4	1	10592	1	0.675	28598	0.15	6355	1.7	72026	0.143	6059	0.14	5932
CONCRETE PUMP	1	23	10592	0.74	0.011	1983	0.002	361	0.018	3245	0.002	361	0.001	180
PICKUP	1	1	10592	1	0.016	169	0.0017	18	0.0017	18	0.0001	1	0.0003	3
CRANE	2	194	1052	0.43	0.009	1580	0.003	527	0.023	4037	0.002	351	0.0015	263
SPECIAL TRK	1	161	1052	0.62	0.02	2100	0.003	315	0.024	2520	0.002	210	0.0015	158
PWR. TOOLS	1	5	748	1	0	0	0	0	0	0	0	0	0	0
PWR. TOOLS	1	5	2190	1	0	0	0	0	0	0	0	0	0	0
PILE HMR.	1	43	5835	0.505	0.013	1647	0.003	380	0.031	3928	0.002	253	0.0015	190
CRANE	1	194	5835	0.43	0.009	4381	0.003	1460	0.023	11195	0.002	974	0.0015	730
AIR COMPRES.	1	37	5835	0.48	0.011	1140	0.002	207	0.018	1865	0.002	207	0.001	104
FRK.LFT 175HP	1	1	5835	1	0.52	3034	0.17	992	1.54	8986	0	0	0.093	543
PICKUP	1	1	2234	1	0.016	36	0.0017	4	0.0017	4	0.0001	0	0.0003	1
BACKHOE	1	79	2234	0.465	0.015	1231	0.003	246	0.022	1805	0.002	164	0.001	82
DUMP TRK.	1	1	2234	1	0.675	1508	0.15	335	1.7	3798	0.143	319	0.14	313
PICKUP	1	1	470	1	0.016	8	0.0017	1	0.0017	1	0.0001	0	0.0003	0
WELDER	1	35	470	0.45	0.011	81	0.002	15	0.018	133	0.002	15	0.001	7
PICKUP	1	1	1094	1	0.016	18	0.0017	2	0.0017	2	0.0001	0	0.0003	0
MOTOR GRADER	3	1	1039	1	0.151	471	0.039	122	0.713	2222	0.086	268	0.061	190
PAVER	1	130	1039	0.62	0.01	837	0.002	167	0.022	1842	0.002	167	0.001	84
ROLLERS	5	1	1039	1	0.3	1559	0.065	338	0.87	4520	0.067	348	0.05	260
DUMP TRK.	21	1	1039	1	0.675	14728	0.15	3273	1.7	37092	0.143	3120	0.14	3055
MOTOR GRADER	1	1	3000	1	0.151	453	0.039	117	0.713	2139	0.086	258	0.061	183
LOADER	1	1	3000	1	0.572	1716	0.23	690	1.9	5700	0.182	546	0.17	510
DUMP TRK.	4	1	3000	1	0.675	8100	0.15	1800	1.7	20400	0.143	1716	0.14	1680
PICKUP	1	1	123	1	0.016	2	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	123	1	1.25	154	0.27	33	3.84	472	0.46	57	0.41	50
LOADER	1	1	123	1	0.572	70	0.23	28	1.9	234	0.182	22	0.17	21
ROLLER	1	1	123	1	0.3	37	0.065	8	0.87	107	0.067	8	0.05	6
DUMP TRK.	14	1	123	1	0.675	1162	0.15	258	1.7	2927	0.143	246	0.14	241
PICKUP	1	1	245	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	245	1	1.25	306	0.27	66	3.84	941	0.46	113	0.41	100
LOADER	1	1	245	1	0.572	140	0.23	56	1.9	466	0.182	45	0.17	42
BALLAST PROF.	1	1	245	1	1.25	306	0.27	66	3.84	941	0.46	113	0.41	100
DUMP TRK.	14	1	245	1	0.675	2315	0.15	515	1.7	5831	0.143	490	0.14	480
PICKUP	1	1	229	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
BACKHOE	1	79	229	0.465	0.015	126	0.003	25	0.022	185	0.002	17	0.001	8
LOADER	1	1	1676	1	0.572	959	0.23	385	1.9	3184	0.182	305	0.17	285
TRACK. WELD.	1	35	1676	0.45	0.011	290	0.002	53	0.018	475	0.002	53	0.001	26
LOADER	1	1	1623	1	0.572	928	0.23	373	1.9	3084	0.182	295	0.17	276

WELDER	1	35	1623	0.45	0.011	281	0.002	51	0.018	460	0.002	51	0.001	26
PICKUP	1	1	1623	1	0.016	26	0.0017	3	0.0017	3	0.0001	0	0.0003	0
LOADER	1	1	5440	1	0.572	3112	0.23	1251	1.9	10336	0.182	990	0.17	925
BACKHOE	1	79	6005	0.465	0.015	3309	0.003	662	0.022	4853	0.002	441	0.001	221
DUMP TRK.	2	1	6005	1	0.675	8107	0.15	1802	1.7	20417	0.143	1717	0.14	1681
PICKUP	1	1	6005	1	0.016	96	0.0017	10	0.0017	10	0.0001	1	0.0003	2
				Total		220514.2		49374.97		511642		43409.17		39641.13

EQUIPMENT APP F	# USED	RATED H P	HOURS	LOAD FACTOR	CARBON MONOXIDE EMISSION FACTOR	CARBON MONOXIDE EMISSION RATE lbs	EXHAUST ROG EMISSION FACTOR	EXHAUST ROG EMISSION RATE lbs	NITROGEN OXIDES EMISSION FACTOR	NITROGEN OXIDES EMISSION RATE lbs	SULFUR OXIDES EMISSION FACTOR	SULFUR OXIDES EMISSION RATE lbs	PARTICULATES EMISSION FACTOR	PARTICULATES EMISSION RATE lbs
BULLDOZER	1	456	2142	0.59	0.0[illegible]	4499	0.002	900	0.021	9448	0.002	900	0.0005	225
MOTOR GRADER	1	1	2142	1	0.151	323	0.039	84	0.713	1527	0.086	184	0.061	131
SCRAPER	1	1	2142	1	1.25	2678	0.27	578	3.84	8225	0.46	985	0.41	878
DUMP TRK	5	1	2142	1	0.675	7229	0.15	1607	1.7	18207	0.143	1532	0.14	1499
PWR. SHOVEL	1	79	3758	0.465	0.015	2071	0.003	414	0.022	3037	0.002	276	0.001	138
WATER TRK	1	1	3758	1	0.675	2537	0.15	564	1.7	6389	0.143	537	0.14	526
PICKUP	1	1	3758	1	0.016	60	0.0017	6	0.0017	6	0.0001	0	0.0003	1
DUMP TRK	24	1	3758	1	0.675	60880	0.15	13529	1.7	153326	0.143	12897	0.14	12627
ROLLER	1	1	654	1	0.3	196	0.065	43	0.87	569	0.067	44	0.05	33
MOTOR GRADER	1	1	654	1	0.151	99	0.039	26	0.713	466	0.086	56	0.061	40
WATER TRK	1	1	327	1	0.675	221	0.15	49	1.7	556	0.143	47	0.14	46
TUNNEL MACH	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
CONVEYOR	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
VENTILATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
JACKS	1	1	0	1	0.675	0	0.15	0	1.7	0	0.143	0	0.14	0
CRANE	1	194	0	0.43	0.009	0	0.003	0	0.023	0	0.002	0	0.0015	0
GENERATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
DRILL RIG	1	209	9315	0.75	0.02	29203	0.003	4380	0.024	35043	0.002	2920	0.0015	2190
TANK TRK	1	1	9315	1	0.675	6288	0.15	1397	1.7	15836	0.143	1332	0.14	1304
PUMP	1	22	9315	0.74	0.011	1668	0.002	303	0.018	2730	0.002	303	0.001	152
CRANE	1	194	11051	0.43	0.009	8297	0.003	2766	0.023	21203	0.002	1844	0.0015	1383
CONCRETE TRK.	4	1	11051	1	0.675	29838	0.15	6631	1.7	75147	0.143	6321	0.14	6189
CONCRETE PUMP	1	23	11051	0.74	0.011	2069	0.002	376	0.018	3386	0.002	376	0.001	188
PICKUP	1	1	11051	1	0.016	177	0.0017	19	0.0017	19	0.0001	1	0.0003	3
CRANE	2	194	1052	0.43	0.009	1580	0.003	527	0.023	4037	0.002	351	0.0015	263
SPECIAL TRK.	1	161	1052	0.62	0.02	2100	0.003	315	0.024	2520	0.002	210	0.0015	158
PWR. TOOLS	1	5	748	1	0	0	0	0	0	0	0	0	0	0
PWR. TOOLS	1	5	4309	1	0	0	0	0	0	0	0	0	0	0
PILE HMR.	1	43	5835	0.505	0.013	1647	0.003	380	0.031	3928	0.002	253	0.0015	190
CRANE	1	194	5835	0.43	0.009	4381	0.003	1460	0.023	11195	0.002	974	0.0015	730
AIR COMPRES.	1	37	5835	0.48	0.011	1140	0.002	207	0.018	1865	0.002	207	0.001	104
FRK.LFT.175HP	1	1	5835	1	0.52	3034	0.17	992	1.54	8986	0	0	0.093	543
PICKUP	1	1	2243	1	0.016	36	0.0017	4	0.0017	4	0.0001	0	0.0003	1
BACKHOE	1	79	2243	0.465	0.015	1236	0.003	247	0.022	1813	0.002	165	0.001	82
DUMP TRK.	1	1	2243	1	0.675	1514	0.15	336	1.7	3813	0.143	321	0.14	314
PICKUP	1	1	470	1	0.016	8	0.0017	1	0.0017	1	0.0001	0	0.0003	0
WELDER	1	35	470	0.45	0.011	81	0.002	15	0.018	133	0.002	15	0.001	7
PICKUP	1	1	990	1	0.016	16	0.0017	2	0.0017	2	0.0001	0	0.0003	0
MOTOR GRADER	3	1	959	1	0.151	434	0.039	112	0.713	2051	0.086	247	0.061	175
PAVER	1	130	959	0.62	0.01	773	0.002	155	0.022	1700	0.002	155	0.001	77
ROLLERS	5	1	959	1	0.3	1439	0.065	312	0.87	4172	0.067	321	0.05	240
DUMP TRK.	21	1	959	1	0.675	13594	0.15	3021	1.7	34236	0.143	2880	0.14	2819
MOTOR GRADER	1	1	2691	1	0.151	406	0.039	105	0.713	1919	0.086	231	0.061	164
LOADER	1	1	2691	1	0.572	1539	0.23	619	1.9	5113	0.182	490	0.17	457
DUMP TRK.	4	1	2691	1	0.675	7266	0.15	1615	1.7	18299	0.143	1539	0.14	1507
PICKUP	1	1	119	1	0.016	2	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	119	1	1.25	149	0.27	32	3.84	457	0.46	55	0.41	49
LOADER	1	1	119	1	0.572	68	0.23	27	1.9	226	0.182	22	0.17	20
ROLLER	1	1	119	1	0.3	36	0.065	8	0.87	104	0.067	8	0.05	6
DUMP TRK.	14	1	119	1	0.675	1125	0.15	250	1.7	2832	0.143	238	0.14	233
PICKUP	1	1	237	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	237	1	1.25	296	0.27	64	3.84	910	0.46	109	0.41	97
LOADER	1	1	237	1	0.572	136	0.23	55	1.9	450	0.182	43	0.17	40
BALLAST PROF.	1	1	237	1	1.25	296	0.27	64	3.84	910	0.46	109	0.41	97
DUMP TRK.	14	1	237	1	0.675	2240	0.15	498	1.7	5641	0.143	474	0.14	465
PICKUP	1	1	327	1	0.016	5	0.0017	1	0.0017	1	0.0001	0	0.0003	0
BACKHOE	1	79	327	0.465	0.015	180	0.003	36	0.022	264	0.002	24	0.001	12
LOADER	1	1	1639	1	0.572	938	0.23	377	1.9	3114	0.182	298	0.17	279
TRACK. WELD.	1	35	1639	0.45	0.011	284	0.002	52	0.018	465	0.002	52	0.001	26
LOADER	1	1	1623	1	0.572	928	0.23	373	1.9	3084	0.182	295	0.17	276

WELDER	1	35	1623	0.45	0.011	281	0.002	51	0.018	460	0.002	51	0.001	26
PICKUP	1	1	1623	1	0.016	26	0.0017	3	0.0017	3	0.0001	0	0.0003	0
LOADER	1	1	5440	1	0.572	3112	0.23	1251	1.9	10336	0.182	990	0.17	925
BACKHOE	1	79	5724	0.465	0.015	3154	0.003	631	0.022	4626	0.002	421	0.001	210
DUMP TRK	2	1	5724	1	0.675	7727	0.15	1717	1.7	19462	0.143	1637	0.14	1603
PICKUP	1	1	5724	1	0.016	92	0.0017	10	0.0017	10	0.0001	1	0.0003	2
				Total		221631.9		49593.36		514260.8		43743.58		39750.77

EQUIPMENT APP F-6	# USED	RATED HP	HOURS	LOAD FACTOR	CARBON MONOXIDE EMISSION FACTOR	CARBON MONOXIDE EMISSION RATE lbs.	EXHAUST ROG EMISSION FACTOR	EXHAUST ROG EMISSION RATE lbs	NITROGEN OXIDES EMISSION FACTOR	NITROGEN OXIDES EMISSION RATE lbs.	SULFUR OXIDES EMISSION FACTOR	SULFUR OXIDES EMISSION RATE lbs.	PARTICULATES EMISSION FACTOR	PARTICULATES EMISSION RATE lbs
BULLDOZER	1	356	2159	0.59	0.01	4535	0.002	907	0.021	9523	0.002	907	0.0005	227
MOTOR GRADER	1	1	2159	1	0.151	326	0.039	84	0.713	1539	0.086	186	0.061	132
SCRAPER	1	1	2159	1	1.25	2699	0.27	583	3.84	8291	0.46	993	0.41	885
DUMP TRK	5	1	2159	1	0.675	7287	0.15	1619	1.7	18352	0.143	1544	0.14	1511
PWR SHOVEL	1	79	3782	0.465	0.015	2084	0.003	417	0.022	3056	0.002	278	0.001	139
WATER TRK	1	1	3782	1	0.675	2553	0.15	567	1.7	6429	0.143	541	0.14	529
PICKUP	1	1	3782	1	0.016	61	0.0017	6	0.0017	6	0.0001	0	0.0003	1
DUMP TRK	24	1	3782	1	0.675	61268	0.15	13615	1.7	154306	0.143	12980	0.14	12708
ROLLER	1	1	829	1	0.3	249	0.065	54	0.87	721	0.067	56	0.05	41
MOTOR GRADER	1	1	829	1	0.151	125	0.039	32	0.713	591	0.086	71	0.061	51
WATER TRK	1	1	414	1	0.675	279	0.15	62	1.7	704	0.143	59	0.14	58
TUNNEL MACH	1	450	560	0.695	0.02	3503	0.003	525	0.022	3853	0.002	350	0.0015	263
CONVEYOR	1	450	560	0.695	0.02	3503	0.003	525	0.022	3853	0.002	350	0.0015	263
VENTILATOR	1	22	560	0.74	0.011	100	0.002	18	0.018	164	0.002	18	0.001	9
JACKS	1	1	560	1	0.675	378	0.15	84	1.7	952	0.143	80	0.14	78
CRANE	1	194	560	0.43	0.009	420	0.003	140	0.023	1074	0.002	93	0.0015	70
GENERATOR	1	22	560	0.74	0.011	100	0.002	18	0.018	164	0.002	18	0.001	9
DRILL RIG	1	209	945	0.75	0.02	2963	0.003	444	0.024	3555	0.002	296	0.0015	222
TANK TRK	1	1	945	1	0.675	638	0.15	142	1.7	1607	0.143	135	0.14	132
PUMR	1	22	945	0.74	0.011	169	0.002	31	0.018	277	0.002	31	0.001	15
CRANE	1	194	10610	0.43	0.009	7966	0.003	2655	0.023	20357	0.002	1770	0.0015	1328
CONCRETE TRK	4	1	10610	1	0.675	28647	0.15	6366	1.7	72148	0.143	6069	0.14	5942
CONCRETE PUMR	1	23	10610	0.74	0.011	1986	0.002	361	0.018	3250	0.002	361	0.001	181
PICKUR	1	1	10610	1	0.016	170	0.0017	18	0.0017	18	0.0001	1	0.0003	3
CRANE	2	194	107	0.43	0.009	161	0.003	54	0.023	411	0.002	36	0.0015	27
SRECIAL TRK.	1	161	107	0.62	0.02	214	0.003	32	0.024	256	0.002	21	0.0015	16
PWR TOOLS	1	5	1612	1	0	0	0	0	0	0	0	0	0	0
PWR. TOOLS	1	5	3850	1	0	0	0	0	0	0	0	0	0	0
PILE HMR.	1	43	5852	0.505	0.013	1652	0.003	381	0.031	3939	0.002	254	0.0015	191
CRANE	1	194	5852	0.43	0.009	4394	0.003	1465	0.023	11228	0.002	976	0.0015	732
AIR COMRRES.	1	37	5852	0.48	0.011	1143	0.002	208	0.018	1871	0.002	208	0.001	104
FRK.LFT.175HP	1	1	5852	1	0.52	3043	0.17	995	1.54	9012	0	0	0.093	544
PICKUR	1	1	2276	1	0.016	36	0.0017	4	0.0017	4	0.0001	0	0.0003	1
BACKHOE	1	79	2276	0.465	0.015	1254	0.003	251	0.022	1839	0.002	167	0.001	84
DUMP TRK.	1	1	2276	1	0.675	1536	0.15	341	1.7	3869	0.143	325	0.14	319
PICKUP	1	1	358	1	0.016	6	0.0017	1	0.0017	1	0.0001	0	0.0003	0
WELDER	1	35	358	0.45	0.011	62	0.002	11	0.018	101	0.002	11	0.001	6
PICKUP	1	1	1110	1	0.016	18	0.0017	2	0.0017	2	0.0001	0	0.0003	0
MOTOR GRADER	3	1	563	1	0.151	255	0.039	66	0.713	1204	0.086	145	0.061	103
RAVER	1	130	563	0.62	0.01	454	0.002	91	0.022	998	0.002	91	0.001	45
ROLLERS	5	1	563	1	0.3	845	0.065	183	0.87	2449	0.067	189	0.05	141
DUMP TRK.	21	1	563	1	0.675	7981	0.15	1773	1.7	20099	0.143	1691	0.14	1655
MOTOR GRADER	1	1	1851	1	0.151	280	0.039	72	0.713	1320	0.086	159	0.061	113
LOADER	1	1	1851	1	0.572	1059	0.23	426	1.9	3517	0.182	337	0.17	315
DUMP TRK.	4	1	1851	1	0.675	4998	0.15	1111	1.7	12587	0.143	1059	0.14	1037
PICKUR	1	1	223	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	223	1	1.25	279	0.27	60	3.84	856	0.46	103	0.41	91
LOADER	1	1	223	1	0.572	128	0.23	51	1.9	424	0.182	41	0.17	38
ROLLER	1	1	223	1	0.3	67	0.065	14	0.87	194	0.067	15	0.05	11
DUMR TRK.	14	1	223	1	0.675	2107	0.15	468	1.7	5307	0.143	446	0.14	437
PICKUR	1	1	446	1	0.016	7	0.0017	1	0.0017	1	0.0001	0	0.0003	0
TAMRER LINER	1	1	446	1	1.25	558	0.27	120	3.84	1713	0.46	205	0.41	183
LOADER	1	1	446	1	0.572	255	0.23	103	1.9	847	0.182	81	0.17	76
BALLAST RROF.	1	1	446	1	1.25	558	0.27	120	3.84	1713	0.46	205	0.41	183
DUMP TRK.	14	1	446	1	0.675	4215	0.15	937	1.7	10615	0.143	893	0.14	874
PICKUR	1	1	465	1	0.016	7	0.0017	1	0.0017	1	0.0001	0	0.0003	0
BACKHOE	1	79	465	0.465	0.015	256	0.003	51	0.022	376	0.002	34	0.001	17
LOADER	1	1	2024	1	0.572	1158	0.23	466	1.9	3846	0.182	368	0.17	344
TRACK. WELD.	1	35	2024	0.45	0.011	351	0.002	64	0.018	574	0.002	64	0.001	32
LOADER	1	1	1757	1	0.572	1005	0.23	404	1.9	3338	0.182	320	0.17	299

WELDER	1	35	1757	0.45	0.011	304	0.002	55	0.018	498	0.002	55	0.001	28
PICKUP	1	1	1757	1	0.016	28	0.0017	3	0.0017	3	0.0001	0	0.0003	1
LOADER	1	1	5832	1	0.572	3336	0.23	1341	1.9	11081	0.182	1061	0.17	991
BACKHOE	1	79	6354	0.465	0.015	3501	0.003	700	0.022	5135	0.002	467	0.001	233
DUMP TRK.	2	1	6354	1	0.675	8578	0.15	1906	1.7	21604	0.143	1817	0.14	1779
PICKUP	1	1	6354	1	0.016	102	0.0017	11	0.0017	11	0.0001	1	0.0003	2
			Total			188199.1		43619.49		457634.8		39035.07		35847.76

EQUIPMENT APP F-[illegible]	# USED	RATED H.P.	HOURS	LOAD FACTOR	CARBON MONOXIDE EMISSION FACTOR	CARBON MONOXIDE EMISSION RATE lbs	EXHAUST ROG EMISSION FACTOR	EXHAUST ROG EMISSION RATE lbs	NITROGEN OXIDES EMISSION FACTOR	NITROGEN OXIDES EMISSION RATE lbs	SULFUR OXIDES EMISSION FACTOR	SULFUR OXIDES EMISSION RATE lbs	PARTICULATES EMISSION FACTOR	PARTICULATES EMISSION RATE lbs
BULLDOZER	1	356	2367	0.59	0.01	4972	0.002	994	0.021	10440	0.002	994	0.0005	[illegible]49
MOTOR GRADER	1	1	2367	1	0.151	357	0.039	92	0.713	1688	0.086	204	0.061	144
SCRAPER	1	1	2367	1	1.25	2959	0.27	639	3.84	9089	0.46	1089	0.41	970
DUMP TRK	5	1	2367	1	0.675	7989	0.15	1775	1.7	20120	0.143	1692	0.14	165[illegible]
PWR SHOVEL	1	79	3728	0.465	0.015	2054	0.003	411	0.022	3013	0.002	274	0.001	[illegible]
WATER TRK	1	1	3728	1	0.675	2516	0.15	559	1.7	6338	0.143	533	0.14	[illegible]
PICKUP	1	1	3728	1	0.016	60	0.0017	6	0.0017	6	0.0001	0	0.0003	1
DUMP TRK	24	1	3728	1	0.675	60394	0.15	13421	1.7	152102	0.143	12794	0.14	12526
ROLLER	1	1	846	1	0.3	254	0.065	55	0.87	736	0.067	57	0.05	42
MOTOR GRADER	1	1	846	1	0.151	128	0.039	33	0.713	603	0.086	73	0.061	52
WATER TRK.	1	1	423	1	0.675	286	0.15	63	1.7	719	0.143	60	0.14	59
TUNNEL MACH.	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
CONVEYOR	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
VENTILATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
JACKS	1	1	0	1	0.675	0	0.15	0	1.7	0	0.143	0	0.14	0
CRANE	1	194	0	0.43	0.009	0	0.003	0	0.023	0	0.002	0	0.0015	0
GENERATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
DRILL RIG	1	209	945	0.75	0.02	2963	0.003	444	0.024	3555	0.002	296	0.0015	222
TANK TRK	1	1	945	1	0.675	638	0.15	142	1.7	1607	0.143	135	0.14	132
PUMP	1	22	945	0.74	0.011	169	0.002	31	0.018	277	0.002	31	0.001	15
CRANE	1	194	10606	0.43	0.009	7963	0.003	2654	0.023	20349	0.002	1770	0.0015	1327
CONCRETE TRK.	4	1	10606	1	0.675	28636	0.15	6364	1.7	72121	0.143	6067	0.14	5939
CONCRETE PUMP	1	23	10606	0.74	0.011	1986	0.002	361	0.018	3249	0.002	361	0.001	181
PICKUP	1	1	10606	1	0.016	170	0.0017	18	0.0017	18	0.0001	1	0.0003	3
CRANE	2	194	107	0.43	0.009	161	0.003	54	0.023	411	0.002	36	0.0015	27
SPECIAL TRK.	1	161	107	0.62	0.02	214	0.003	32	0.024	256	0.002	21	0.0015	16
PWR TOOLS	1	5	1612	1	0	0	0	0	0	0	0	0	0	0
PWR TOOLS	1	5	1283	1	0	0	0	0	0	0	0	0	0	0
PILE HMR	1	43	5911	0.505	0.013	1669	0.003	385	0.031	3979	0.002	257	0.0015	193
CRANE	1	194	5911	0.43	0.009	4438	0.003	1479	0.023	11341	0.002	986	0.0015	740
AIR COMPRES.	1	37	5911	0.48	0.011	1155	0.002	210	0.018	1890	0.002	210	0.001	105
FRK.LFT.175HP	1	1	5911	1	0.52	3074	0.17	1005	1.54	9103	0	0	0.093	550
PICKUP	1	1	2257	1	0.016	36	0.0017	4	0.0017	4	0.0001	0	0.0003	1
BACKHOE	1	79	2257	0.465	0.015	1244	0.003	249	0.022	1824	0.002	166	0.001	83
DUMP TRK.	1	1	2257	1	0.675	1523	0.15	339	1.7	3837	0.143	323	0.14	316
PICKUP	1	1	302	1	0.016	5	0.0017	1	0.0017	1	0.0001	0	0.0003	0
WELDER	1	35	302	0.45	0.011	52	0.002	10	0.018	86	0.002	10	0.001	5
PICKUP	1	1	1086	1	0.016	17	0.0017	2	0.0017	2	0.0001	0	0.0003	0
MOTOR GRADER	3	1	1014	1	0.151	459	0.039	119	0.713	2169	0.086	262	0.061	186
PAVER	1	130	1014	0.62	0.01	817	0.002	163	0.022	1798	0.002	163	0.001	82
ROLLERS	5	1	1014	1	0.3	1521	0.065	330	0.87	4411	0.067	340	0.05	254
DUMP TRK.	21	1	1014	1	0.675	14373	0.15	3194	1.7	36200	0.143	3045	0.14	2981
MOTOR GRADER	1	1	2088	1	0.151	315	0.039	81	0.713	1489	0.086	180	0.061	127
LOADER	1	1	2088	1	0.572	1194	0.23	480	1.9	3967	0.182	380	0.17	355
DUMP TRK.	4	1	2088	1	0.675	5638	0.15	1253	1.7	14198	0.143	1194	0.14	1169
PICKUP	1	1	221	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	221	1	1.25	276	0.27	60	3.84	849	0.46	102	0.41	91
LOADER	1	1	221	1	0.572	126	0.23	51	1.9	420	0.182	40	0.17	38
ROLLER	1	1	221	1	0.3	66	0.065	14	0.87	192	0.067	15	0.05	11
DUMP TRK.	14	1	221	1	0.675	2088	0.15	464	1.7	5260	0.143	442	0.14	433
PICKUP	1	1	442	1	0.016	7	0.0017	1	0.0017	1	0.0001	0	0.0003	0
TAMPER LINER	1	1	442	1	1.25	553	0.27	119	3.84	1697	0.46	203	0.41	181
LOADER	1	1	442	1	0.572	253	0.23	102	1.9	840	0.182	80	0.17	75
BALLAST PROF.	1	1	442	1	1.25	553	0.27	119	3.84	1697	0.46	203	0.41	181
DUMP TRK.	14	1	442	1	0.675	4177	0.15	928	1.7	10520	0.143	885	0.14	866
PICKUP	1	1	487	1	0.016	8	0.0017	1	0.0017	1	0.0001	0	0.0003	0
BACKHOE	1	79	487	0.465	0.015	268	0.003	54	0.022	394	0.002	36	0.001	18
LOADER	1	1	1898	1	0.572	1086	0.23	437	1.9	3606	0.182	345	0.17	323
TRACK. WELD.	1	35	1898	0.45	0.011	329	0.002	60	0.018	538	0.002	60	0.001	30
LOADER	1	1	1711	1	0.572	979	0.23	394	1.9	3251	0.182	311	0.17	291

WELDER	1	35	1711	0.45	0.011	296	0.002	54	0.018	485	0.002	54	0.001	27
PICKUP	1	1	1711	1	0.016	27	0.0017	3	0.0017	3	0.0001	0	0.0003	1
LOADER	1	1	5672	1	0.572	3244	0.23	1305	1.9	10777	0.182	1032	0.17	964
BACKHOE	1	79	0	0.465	0.015	0	0.003	0	0.022	0	0.002	0	0.001	0
DUMP TRK.	2	1	0	1	0.675	0	0.15	0	1.7	0	0.143	0	0.14	0
PICKUP	1	1	0	1	0.016	0	0.0017	0	0.0017	0	0.0001	0	0.0003	0
				Total		176737		41615.77		443524.9		37813.39		34897.22

EQUIPMENT AREA #	# USED	RATED H P	HOURS	LOAD FACTOR	CARBON MONOXIDE EMISSION FACTOR	CARBON MONOXIDE EMISSION RATE lbs	EXHAUST ROG EMISSION FACTOR	EXHAUST ROG EMISSION RATE lbs	NITROGEN OXIDES EMISSION FACTOR	NITROGEN OXIDES EMISSION RATE lbs	SULFUR OXIDES EMISSION FACTOR	SULFUR OXIDES EMISSION RATE lbs	PARTICULATES EMISSION FACTOR	PARTICULATES EMISSION RATE lbs
BULLDOZER	1	356	2651	0.59	0.01	5568	0.002	1114	0.021	11693	0.002	1114	0.0005	[illegible]
MOTOR GRADER	1	1	2651	1	0.151	400	0.039	103	0.713	1890	0.086	228	0.061	16[illegible]
SCRAPER	1	1	2651	1	1.25	3314	0.27	716	3.84	10180	0.46	1219	0.41	108[illegible]
DUMP TRK.	5	1	2651	1	0.675	8947	0.15	1988	1.7	22534	0.143	1895	0.14	185[illegible]
PWR. SHOVEL	1	79	3690	0.465	0.015	2033	0.00[illegible]	407	0.022	2982	0.002	271	0.001	[illegible]
WATER TRK.	1	1	3690	1	0.675	2491	0.15	554	1.7	6273	0.143	528	0.14	51[illegible]
PICKUP	1	1	3690	1	0.016	59	0.0017	6	0.0017	6	0.0001	0	0.0003	[illegible]
DUMP TRK.	24	1	3690	1	0.675	59778	0.15	13284	1.7	150552	0.143	12664	0.14	12398
ROLLER	1	1	848	1	0.3	254	0.065	55	0.87	738	0.067	57	0.05	42
MOTOR GRADER	1	1	848	1	0.151	128	0.039	33	0.713	6[illegible]5	0.086	73	0.061	52
WATER TRK.	1	1	424	1	0.675	286	0.15	64	1.7	721	0.143	61	0.14	59
TUNNEL MACH	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
CONVEYOR	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
VENTILATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
JACKS	1	1	0	1	0.675	0	0.15	0	1.7	0	0.143	0	0.14	0
CRANE	1	194	0	0.43	0.009	0	0.003	0	0.023	0	0.002	0	0.0015	0
GENERATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
DRILL RIG	1	209	945	0.75	0.02	2963	0.003	444	0.024	3555	0.002	296	0.0015	222
TANK TRK.	1	1	945	1	0.675	638	0.15	142	1.7	1607	0.143	135	0.14	132
PUMP	1	22	945	0.74	0.011	169	0.002	31	0.018	277	0.002	31	0.001	15
CRANE	1	194	10623	0.43	0.009	7976	0.003	2659	0.023	20382	0.002	1772	0.0015	1329
CONCRETE TRK	4	1	10623	1	0.675	28682	0.15	6374	1.7	72236	0.143	6076	0.14	5949
CONCRETE PUMP	1	23	10623	0.74	0.011	1989	0.002	362	0.018	3254	0.002	362	0.001	181
PICKUP	1	1	10623	1	0.016	170	0.0017	18	0.0017	18	0.0001	1	0.0003	3
CRANE	2	194	107	0.43	0.009	161	0.003	54	0.023	411	0.002	36	0.0015	27
SPECIAL TRK.	1	161	107	0.62	0.02	214	0.003	32	0.024	256	0.002	21	0.0015	16
PWR. TOOLS	1	5	1612	1	0	0	0	0	0	0	0	0	0	0
PWR. TOOLS	1	5	1475	1	0	0	0	0	0	0	0	0	0	0
PILE HMR.	1	43	5860	0.505	0.013	1654	0.003	382	0.031	3945	0.002	254	0.0015	191
CRANE	1	194	5860	0.43	0.009	4400	0.003	1467	0.023	11243	0.002	978	0.0015	733
AIR COMPRES.	1	37	5860	0.48	0.011	1145	0.002	208	0.018	1873	0.002	208	0.001	104
FRK.LFT.175HP	1	1	5860	1	0.52	3047	0.17	996	1.54	9024	0	0	0.093	545
PICKUP	1	1	2241	1	0.016	36	0.0017	4	0.0017	4	0.0001	0	0.0003	1
BACKHOE	1	79	2241	0.465	0.015	1235	0.003	247	0.022	1811	0.002	165	0.001	82
DUMP TRK.	1	1	2241	1	0.675	1513	0.15	336	1.7	3810	0.143	320	0.14	314
PICKUP	1	1	350	1	0.016	6	0.0017	1	0.0017	1	0.0001	0	0.0003	0
WELDER	1	35	350	0.45	0.011	61	0.002	11	0.018	99	0.002	11	0.001	6
PICKUP	1	1	1158	1	0.016	19	0.0017	2	0.0017	2	0.0001	0	0.0003	0
MOTOR GRADER	3	1	10205	1	0.151	4623	0.039	1194	0.713	21828	0.086	2633	0.061	1868
PAVER	1	130	10205	0.62	0.01	8225	0.002	1645	0.022	18096	0.002	1645	0.001	823
ROLLERS	5	1	10205	1	0.3	15308	0.065	3317	0.87	44392	0.067	3419	0.05	2551
DUMP TRK.	21	1	10205	1	0.675	144656	0.15	32146	1.7	364319	0.143	30646	0.14	30003
MOTOR GRADER	1	1	2931	1	0.151	443	0.039	114	0.713	2090	0.086	252	0.061	179
LOADER	1	1	2931	1	0.572	1677	0.23	674	1.9	5569	0.182	533	0.17	498
DUMP TRK.	4	1	2931	1	0.675	7914	0.15	1759	1.7	19931	0.143	1677	0.14	1641
PICKUP	1	1	238	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	238	1	1.25	298	0.27	64	3.84	914	0.46	109	0.41	98
LOADER	1	1	238	1	0.572	136	0.23	55	1.9	452	0.182	43	0.17	40
ROLLER	1	1	238	1	0.3	71	0.065	15	0.87	207	0.067	16	0.05	12
DUMP TRK.	14	1	238	1	0.675	2249	0.15	500	1.7	5664	0.143	476	0.14	466
PICKUP	1	1	476	1	0.016	8	0.0017	1	0.0017	1	0.0001	0	0.0003	0
TAMPER LINER	1	1	476	1	1.25	595	0.27	129	3.84	1828	0.46	219	0.41	195
LOADER	1	1	476	1	0.572	272	0.23	109	1.9	904	0.182	87	0.17	81
BALLAST PROF	1	1	476	1	1.25	595	0.27	129	3.84	1828	0.46	219	0.41	195
DUMP TRK.	14	1	476	1	0.675	4498	0.15	1000	1.7	11329	0.143	953	0.14	933
PICKUP	1	1	527	1	0.016	8	0.0017	1	0.0017	1	0.0001	0	0.0003	0
BACKHOE	1	79	527	0.465	0.015	290	0.003	58	0.022	426	0.002	39	0.001	19
LOADER	1	1	1920	1	0.572	1098	0.23	442	1.9	3648	0.182	349	0.17	326
TRACK. WELD.	1	35	1920	0.45	0.011	333	0.002	60	0.018	544	0.002	60	0.001	30
LOADER	1	1	1724	1	0.572	986	0.23	397	1.9	3276	0.182	314	0.17	293

WELDER	1	35	1724	0.45	0.011	299	0.002	54	0.018	489	0.002	54	0.001	27
PICKUP	1	1	1724	1	0.016	28	0.0017	3	0.0017	3	0.0001	0	0.0003	1
LOADER	1	1	5720	1	0.572	3272	0.23	1316	1.9	10868	0.182	1041	0.17	972
BACKHOE	1	79	0	0.465	0.015	0	0.003	0	0.022	0	0.002	0	0.001	0
DUMP TRK.	2	1	0	1	0.675	0	0.15	0	1.7	0	0.143	0	0.14	0
PICKUP	1	1	0	1	0.016	0	0.0017	0	0.0017	0	0.0001	0	0.0003	0
				Total		337217.7		77271.34		860587.6		73562.61		67691.12

EQUIPMENT APP F 9	# USED	PATED H P	HOURS	LOAD FACTOP	APBON MONOXIDE EMISSION FACTOP	APBON MONOXIDE EMISSION RATE lbs	EXHAUST POC EMISSION FACTOP	EXHAUST POC EMISSION RATE lbs	NITPOGEN OXIDES EMISSION FACTOP	NITPOGEN OXIDES EMISSION PATE lbs	SULFUR OXIDES EMISSION FACTOP	SULFUR OXIDES EMISSION PATE lbs	PARTICULATE EMISSION FACTOP	PARTICULATE EMISSION PATE lbs
BULLDOZER	1	356	2422	[illegible]	0.01	5087	0.002	1017	0.021	10683	0.002	1017	0.0005	254
MOTOR GRADER	1	1	2422	1	0.151	366	0.039	94	0.713	1727	0.086	208	0.061	148
SCRAPER	1	1	2422	1	1.25	3028	0.27	654	3.84	[illegible]	0.46	1114	0.41	[illegible]
DUMP TRK	5	1	2422	1	0.675	8174	0.15	1817	1.7	20587	0.143	1732	0.14	[illegible]
PWR SHOVEL	1	79	4502	0.465	0.015	2481	0.003	496	0.022	3638	0.002	331	0.001	[illegible]
WATER TRK	1	1	4502	1	0.675	3039	0.15	675	1.7	7653	0.143	644	0.14	[illegible]
PICKUP	1	1	4502	1	0.016	72	0.0017	8	0.0017	8	0.0001	0	[illegible]	[illegible]
DUMP TRK	24	1	4502	1	0.675	72932	0.15	16207	1.7	183682	0.143	15451	0.14	[illegible]
ROLLER	1	1	926	1	0.3	278	0.065	60	0.87	806	0.067	62	0.05	46
MOTOR GRADER	1	1	926	1	0.151	140	0.039	36	0.713	660	0.086	80	0.061	56
WATER TRK	1	1	463	1	0.675	313	0.15	69	1.7	787	0.143	66	0.14	65
TUNNEL MACH.	1	450	3920	0.695	0.02	24520	0.003	3678	0.022	26972	0.002	2452	0.0015	1839
CONVEYOR	1	450	3920	0.695	0.02	24520	0.003	3678	0.022	26972	0.002	2452	0.0015	1839
VENTILATOR	1	22	3920	0.74	0.011	702	0.002	128	0.018	1149	0.002	128	0.001	64
JACKS	1	1	3920	1	0.675	2646	0.15	588	1.7	6664	0.143	561	0.14	549
CRANE	1	194	3920	0.43	0.009	2943	0.003	981	0.023	7521	0.002	654	0.0015	491
GENERATOP	1	22	3920	0.74	0.011	702	0.002	128	0.018	1149	0.002	128	0.001	64
DPILL RIG	1	209	945	0.75	0.02	2963	0.003	444	0.024	3555	0.002	296	0.0015	222
TANK TRK	1	1	945	1	0.675	638	0.15	142	1.7	1607	0.143	135	0.14	132
PUMP	1	22	945	0.74	0.011	169	0.002	31	0.018	277	0.002	31	0.001	15
CRANE	1	194	12383	0.43	0.009	9297	0.003	3099	0.023	23759	0.002	2066	0.0015	1549
CONCRETE TPK.	4	1	12383	1	0.675	33434	0.15	7430	1.7	84204	0.143	7083	0.14	6934
CONCRETE PUMP	1	23	12383	0.74	0.011	2318	0.002	422	0.018	3794	0.002	422	0.001	211
PICKUP	1	1	12383	1	0.016	198	0.0017	21	0.0017	21	0.0001	1	0.0003	4
CRANE	2	194	107	0.43	0.009	161	0.003	54	0.023	411	0.002	36	0.0015	27
SPECIAL TRK.	1	161	107	0.62	0.02	214	0.003	32	0.024	256	0.002	21	0.0015	16
PWR. TOOLS	1	5	1612	1	0	0	0	0	0	0	0	0	0	0
PWR. TOOLS	1	5	2531	1	0	0	0	0	0	0	0	0	0	0
PILE HMR.	1	43	6776	0.505	0.013	1913	0.003	441	0.031	4561	0.002	294	0.0015	221
CRANE	1	194	6776	0.43	0.009	5087	0.003	1696	0.023	13001	0.002	1131	0.0015	848
AIP COMPRES.	1	37	6776	0.48	0.011	1324	0.002	241	0.018	2166	0.002	241	0.001	120
FRK.LFT.175HP	1	1	6776	1	0.52	3524	0.17	1152	1.54	10435	0	0	0.093	630
PICKUP	1	1	2512	1	0.016	40	0.0017	4	0.0017	4	0.0001	0	0.0003	1
BACKHOE	1	79	2512	0.465	0.015	1384	0.003	277	0.022	2030	0.002	185	0.001	92
DUMP TRK.	1	1	2512	1	0.675	1696	0.15	377	1.7	4270	0.143	359	0.14	352
PICKUP	1	1	278	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
WELDER	1	35	278	0.45	0.011	48	0.002	9	0.018	79	0.002	9	0.001	4
PICKUP	1	1	883	1	0.016	14	0.0017	2	0.0017	2	0.0001	0	0.0003	0
MOTOR GRADER	3	1	925	1	0.151	419	0.039	108	0.713	1979	0.086	239	0.061	169
PAVER	1	130	925	0.62	0.01	746	0.002	149	0.022	1640	0.002	149	0.001	75
ROLLERS	5	1	925	1	0.3	1388	0.065	301	0.87	4024	0.067	310	0.05	231
DUMP TRK.	21	1	925	1	0.675	13112	0.15	2914	1.7	33023	0.143	2778	0.14	2720
MOTOR GRADER	1	1	1793	1	0.151	271	0.039	70	0.713	1278	0.086	154	0.061	109
LOADER	1	1	1793	1	0.572	1026	0.23	412	1.9	3407	0.182	326	0.17	305
DUMP TRK.	4	1	1793	1	0.675	4841	0:15	1076	1.7	12192	0.143	1026	0.14	1004
PICKUP	1	1	120	1	0.016	2	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	120	1	1.25	150	0.27	32	3.84	461	0.46	55	0.41	49
LOADER	1	1	120	1	0.572	69	0.23	28	1.9	228	0.182	22	0.17	20
ROLLER	1	1	120	1	0.3	36	0.065	8	0.87	104	0.067	8	0.05	6
DUMP TRK.	14	1	120	1	0.675	1134	0.15	252	1.7	2856	0.143	240	0.14	235
PICKUP	1	1	240	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	240	1	1.25	300	0.27	65	3.84	922	0.46	110	0.41	98
LOADER	1	1	240	1	0.572	137	0.23	55	1.9	456	0.182	44	0.17	41
BALLAST PROF.	1	1	240	1	1.25	300	0.27	65	3.84	922	0.46	110	0.41	98
DUMP TRK.	14	1	240	1	0.675	2268	0.15	504	1.7	5712	0.143	480	0.14	470
PICKUP	1	1	250	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
BACKHOE	1	79	250	0.465	0.015	138	0.003	28	0.022	202	0.002	18	0.001	9
LOADER	1	1	2148	1	0.572	1229	0.23	494	1.9	4081	0.182	391	0.17	365
TRACK. WELD.	1	35	2148	0.45	0.011	372	0.002	68	0.018	609	0.002	68	0.001	34
LOADER	1	1	1893	1	0.572	1083	0.23	435	1.9	3597	0.182	345	0.17	322

WELDER	1	35	1893	0.45	0.011	328	0.002	60	0.018	537	0.002	60	0.001	30
PICKUP	1	1	1893	1	0.016	30	0.0017	3	0.0017	3	0.0001	0	0.0003	1
LOADER	1	1	6379	1	0.572	3649	0.23	1467	1.9	12120	0.182	1161	0.17	1084
BACKHOE	1	79	6979	0.465	0.015	3846	0.003	769	0.022	5640	0.002	513	0.001	256
DUMP TRK.	2	1	6979	1	0.675	9422	0.15	2094	1.7	23729	0.143	1996	0.14	1954
PICKUP	1	1	6979	1	0.016	112	0.0017	12	0.0017	12	0.0001	1	0.0003	2
				Total		262779		57655.63		584123		49992.09		45095.61

EQUIPMENT APP F-21	# TYPE	RATED H P	HOURS	LOAD FACTOR	ARBON MONOXIDE EMISSION FACTOR	EMISSION RATE lbs	EXHAUST HC EMISSION FACTOR	EMISSION RATE lbs	NITROGEN OXIDES EMISSION FACTOR	EMISSION RATE lbs	SULFUR OXIDES EMISSION FACTOR	EMISSION RATE lbs	PARTICULATE EMISSION FACTOR	EMISSION RATE lbs
BULLDOZER	1	356	897	0.59	0.01	1884	0.002	377	0.021	3957	0.002	377	0.0005	94
MOTOR GRADER	1	1	897	1	0.151	135	0.039	35	0.713	640	0.086	77	0.061	55
SCRAPER	1	1	897	1	1.25	1121	0.27	242	3.84	3444	0.46	413	0.41	368
DUMP TRK	5	1	897	1	0.675	3027	0.15	673	1.7	7625	0.143	641	0.14	628
PWR. SHOVEL	1	79	4458	0.465	0.015	2456	0.003	491	0.022	3603	0.002	328	0.001	164
WATER TRK	1	1	4458	1	0.675	3009	0.15	669	1.7	7579	0.143	637	0.14	624
PICKUP	1	1	4458	1	0.016	71	0.0017	8	0.0017	8	0.0001	0	0.0003	1
DUMP TRK	24	1	4458	1	0.675	72220	0.15	16049	1.7	181886	0.143	15300	0.14	14979
ROLLER	1	1	919	1	0.3	276	0.065	60	0.87	800	0.067	62	0.05	46
MOTOR GRADER	1	1	919	1	0.151	139	0.039	36	0.713	655	0.086	79	0.061	56
WATER TRK	1	1	460	1	0.675	311	0.15	69	1.7	782	0.143	66	0.14	64
TUNNEL MACH	1	450	3920	0.695	0.02	24520	0.003	3678	0.022	26972	0.002	2452	0.0015	1839
CONVEYOR	1	450	3920	0.695	0.02	24520	0.003	3678	0.022	26972	0.002	2452	0.0015	1839
VENTILATOR	1	22	3920	0.74	0.011	702	0.002	128	0.018	1149	0.002	128	0.001	64
JACKS	1	1	3920	1	0.675	2646	0.15	588	1.7	6664	0.143	561	0.14	549
CRANE	1	194	3920	0.43	0.009	2943	0.003	981	0.023	7521	0.002	654	0.0015	491
GENERATOR	1	22	3920	0.74	0.011	702	0.002	128	0.018	1149	0.002	128	0.001	64
DRILL RIG	1	209	945	0.75	0.02	2963	0.003	444	0.024	3555	0.002	296	0.0015	222
TANK TRK.	1	1	945	1	0.675	638	0.15	142	1.7	1607	0.143	135	0.14	132
PUMP	1	22	945	0.74	0.011	169	0.002	31	0.018	277	0.002	31	0.001	15
CRANE	1	194	12697	0.43	0.009	9533	0.003	3178	0.023	24361	0.002	2118	0.0015	1589
CONCRETE TRK	4	1	12697	1	0.675	34282	0.15	7618	1.7	86340	0.143	7263	0.14	7110
CONCRETE PUMP	1	23	12697	0.74	0.011	2377	0.002	432	0.018	3890	0.002	432	0.001	216
PICKUP	1	1	12697	1	0.016	203	0.0017	22	0.0017	22	0.0001	1	0.0003	4
CRANE	2	194	107	0.43	0.009	161	0.003	54	0.023	411	0.002	36	0.0015	27
SPECIAL TRK.	1	161	107	0.62	0.02	214	0.003	32	0.024	256	0.002	21	0.0015	16
PWR. TOOLS	1	5	1612	1	0	0	0	0	0	0	0	0	0	0
PWR. TOOLS	1	5	4874	1	0	0	0	0	0	0	0	0	0	0
PILE HMR.	1	43	6716	0.505	0.013	1896	0.003	438	0.031	4521	0.002	292	0.0015	219
CRANE	1	194	6716	0.43	0.009	5042	0.003	1681	0.023	12886	0.002	1120	0.0015	840
AIR COMPRES.	1	37	6716	0.48	0.011	1312	0.002	239	0.018	2147	0.002	239	0.001	119
FRK.LFT.175HP	1	1	6716	1	0.52	3492	0.17	1142	1.54	10343	0	0	0.093	625
PICKUP	1	1	2484	1	0.016	40	0.0017	4	0.0017	4	0.0001	0	0.0003	1
BACKHOE	1	79	2484	0.465	0.015	1369	0.003	274	0.022	2007	0.002	182	0.001	91
DUMP TRK.	1	1	2484	1	0.675	1677	0.15	373	1.7	4223	0.143	355	0.14	348
PICKUP	1	1	334	1	0.016	5	0.0017	1	0.0017	1	0.0001	0	0.0003	0
WELDER	1	35	334	0.45	0.011	58	0.002	11	0.018	95	0.002	11	0.001	5
PICKUP	1	1	939	1	0.016	15	0.0017	2	0.0017	2	0.0001	0	0.0003	0
MOTOR GRADER	3	1	1126	1	0.151	510	0.039	132	0.713	2409	0.086	291	0.061	206
PAVER	1	130	1126	0.62	0.01	908	0.002	182	0.022	1997	0.002	182	0.001	91
ROLLERS	5	1	1126	1	0.3	1689	0.065	366	0.87	4898	0.067	377	0.05	282
DUMP TRK.	21	1	1126	1	0.675	15961	0.15	3547	1.7	40198	0.143	3381	0.14	3310
MOTOR GRADER	1	1	2633	1	0.151	398	0.039	103	0.713	1877	0.086	226	0.061	161
LOADER	1	1	2633	1	0.572	1506	0.23	606	1.9	5003	0.182	479	0.17	448
DUMP TRK.	4	1	2633	1	0.675	7109	0.15	1580	1.7	17904	0.143	1506	0.14	1474
PICKUP	1	1	132	1	0.016	2	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	132	1	1.25	165	0.27	36	3.84	507	0.46	61	0.41	54
LOADER	1	1	132	1	0.572	76	0.23	30	1.9	251	0.182	24	0.17	22
ROLLER	1	1	132	1	0.3	40	0.065	9	0.87	115	0.067	9	0.05	7
DUMP TRK.	14	1	132	1	0.675	1247	0.15	277	1.7	3142	0.143	264	0.14	259
PICKUP	1	1	264	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	264	1	1.25	330	0.27	71	3.84	1014	0.46	121	0.41	108
LOADER	1	1	264	1	0.572	151	0.23	61	1.9	502	0.182	48	0.17	45
BALLAST PROF.	1	1	264	1	1.25	330	0.27	71	3.84	1014	0.46	121	0.41	108
DUMP TRK.	14	1	264	1	0.675	2495	0.15	554	1.7	6283	0.143	529	0.14	517
PICKUP	1	1	278	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
BACKHOE	1	79	278	0.465	0.015	153	0.003	31	0.022	225	0.002	20	0.001	10
LOADER	1	1	2148	1	0.572	1229	0.23	494	1.9	4081	0.182	391	0.17	365
TRACK. WELD.	1	35	2148	0.45	0.011	372	0.002	68	0.018	609	0.002	68	0.001	34
LOADER	1	1	1893	1	0.572	1083	0.23	435	1.9	3597	0.182	345	0.17	322

WELDER	1	35	1893	0.45	0.011	328	0.002	60	0.018	537	0.002	60	0.001	30
PICKUP	1	1	1893	1	0.016	30	0.0017	3	0.0017	3	0.0001	0	0.0003	1
LOADER	1	1	6379	1	0.572	3649	0.23	1467	1.9	12120	0.182	1161	0.17	1084
BACKHOE	1	79	6979	0.465	0.015	3846	0.003	769	0.022	5640	0.002	513	0.001	256
DUMP TRK.	2	1	6979	1	0.675	9422	0.15	2094	1.7	23729	0.143	1996	0.14	1954
PICKUP	1	1	6979	1	0.016	112	0.0017	12	0.0017	12	0.0001	1	0.0003	2
				Total		259273.9		57058.91		576014		49059.98		44654.81

EQUIPMENT APP F [illegible]	# USED	RATED HP	HOURS	LOAD FACTOR	CARBON MONOXIDE EMISSION FACTOR	CARBON MONOXIDE EMISSION RATE lbs	EXHAUST HC EMISSION FACTOR	EXHAUST HC EMISSION RATE lbs	NITROGEN OXIDES EMISSION FACTOR	NITROGEN OXIDES EMISSION RATE lbs	SULFUR OXIDES EMISSION FACTOR	SULFUR OXIDES EMISSION RATE lbs	PARTICULATES EMISSION FACTOR	PARTICULATES EMISSION RATE lbs
[illegible]ER	1	356	691	0.59	[illegible]	1451	[illegible]	[illegible]90	0.021	3048	[illegible]	290	0.0005	[illegible]
MOTOR GRADER	1	1	691	[illegible]	[illegible]	104	0.039	27	0.713	493	0.086	[illegible]9	0.061	4[illegible]
SCRAPER	1	1	691	1	[illegible].25	864	0.27	187	3.84	265[illegible]	0.46	318	0.41	28[illegible]
DUMP TRK	5	1	691	1	0.675	2332	0.15	518	1.7	5874	0.143	494	0.14	484
PWR. SHOVEL	1	79	3378	0.465	0.015	1861	0.003	372	0.022	2730	0.002	248	0.001	124
WATER TRK	1	1	3378	1	0.675	2280	0.15	507	1.7	5743	0.143	483	0.14	47[illegible]
PICKUP	1	1	3378	1	0.016	54	0.0017	6	0.0017	6	0.0001	0	0.0003	[illegible]
DUMP TRK	24	1	3378	1	0.675	54724	0.15	12161	1.7	137822	0.143	11593	0.14	11350
ROLLER	1	1	798	1	0.3	239	0.065	52	0.87	694	0.067	53	0.05	40
MOTOR GRADER	1	1	798	1	0.151	120	0.039	31	0.713	569	0.086	69	0.061	49
WATER TRK	1	1	399	1	0.675	269	0.15	60	1.7	678	0.143	57	0.14	56
TUNNEL MACH	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
CONVEYOR	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
VENTILATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
JACKS	1	1	0	1	0.675	0	0.15	0	1.7	0	0.143	0	0.14	0
CRANE	1	194	0	0.43	0.009	0	0.003	0	0.023	0	0.002	0	0.0015	0
GENERATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
DRILL RIG	1	209	945	0.75	0.02	2963	0.003	444	0.024	3555	0.002	296	0.0015	222
TANK TRK	1	1	945	1	0.675	638	0.15	142	1.7	1607	0.143	135	0.14	132
PUMP	1	22	945	0.74	0.011	169	0.002	31	0.018	277	0.002	31	0.001	15
CRANE	1	194	8965	0.43	0.009	6731	0.003	2244	0.023	17201	0.002	1496	0.0015	1122
CONCRETE TRK	4	1	8965	1	0.675	24206	0.15	5379	1.7	60962	0.143	5128	0.14	5020
CONCRETE PUMP	1	23	8965	0.74	0.011	1678	0.002	305	0.018	2747	0.002	305	0.001	153
PICKUP	1	1	8965	1	0.016	143	0.0017	15	0.0017	15	0.0001	1	0.0003	3
CRANE	2	194	107	0.43	0.009	161	0.003	54	0.023	411	0.002	36	0.0015	27
SPECIAL TRK.	1	161	107	0.62	0.02	214	0.003	32	0.024	256	0.002	21	0.0015	16
PWR. TOOLS	1	5	1612	1	0	0	0	0	0	0	0	0	0	0
PWR. TOOLS	1	5	3402	1	0	0	0	0	0	0	0	0	0	0
PILE HMR.	1	43	5657	0.505	0.013	1597	0.003	369	0.031	3808	0.002	246	0.0015	184
CRANE	1	194	5657	0.43	0.009	4247	0.003	1416	0.023	10854	0.002	944	0.0015	708
AIR COMPRES.	1	37	5657	0.48	0.011	1105	0.002	201	0.018	1808	0.002	201	0.001	100
FRK.LFT.175HP	1	1	5657	1	0.52	2942	0.17	962	1.54	8712	0	0	0.093	526
PICKUP	1	1	2173	1	0.016	35	0.0017	4	0.0017	4	0.0001	0	0.0003	1
BACKHOE	1	79	2173	0.465	0.015	1197	0.003	239	0.022	1756	0.002	160	0.001	80
DUMP TRK.	1	1	2173	1	0.675	1467	0.15	326	1.7	3694	0.143	311	0.14	304
PICKUP	1	1	302	1	0.016	5	0.0017	1	0.0017	1	0.0001	0	0.0003	0
WELDER	1	35	302	0.45	0.011	52	0.002	10	0.018	86	0.002	10	0.001	5
PICKUP	1	1	918	1	0.016	15	0.0017	2	0.0017	2	0.0001	0	0.0003	0
MOTOR GRADER	3	1	861	1	0.151	390	0.039	101	0.713	1842	0.086	222	0.061	158
PAVER	1	130	861	0.62	0.01	694	0.002	139	0.022	1527	0.002	139	0.001	69
ROLLERS	5	1	861	1	0.3	1292	0.065	280	0.87	3745	0.067	288	0.05	215
DUMP TRK.	21	1	861	1	0.675	12205	0.15	2712	1.7	30738	0.143	2586	0.14	2531
MOTOR GRADER	1	1	1592	1	0.151	240	0.039	62	0.713	1135	0.086	137	0.061	97
LOADER	1	1	1592	1	0.572	911	0.23	366	1.9	3025	0.182	290	0.17	271
DUMP TRK.	4	1	1592	1	0.675	4298	0.15	955	1.7	10826	0.143	911	0.14	892
PICKUP	1	1	126	1	0.016	2	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	126	1	1.25	158	0.27	34	3.84	484	0.46	58	0.41	52
LOADER	1	1	126	1	0.572	72	0.23	29	1.9	239	0.182	23	0.17	21
ROLLER	1	1	126	1	0.3	38	0.065	8	0.87	110	0.067	8	0.05	6
DUMP TRK.	14	1	126	1	0.675	1191	0.15	265	1.7	2999	0.143	252	0.14	247
PICKUP	1	1	253	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	253	1	1.25	316	0.27	68	3.84	972	0.46	116	0.41	104
LOADER	1	1	253	1	0.572	145	0.23	58	1.9	481	0.182	46	0.17	43
BALLAST PROF.	1	1	253	1	1.25	316	0.27	68	3.84	972	0.46	116	0.41	104
DUMP TRK.	14	1	253	1	0.675	2391	0.15	531	1.7	6021	0.143	507	0.14	496
PICKUP	1	1	255	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
BACKHOE	1	79	255	0.465	0.015	141	0.003	28	0.022	206	0.002	19	0.001	9
LOADER	1	1	1468	1	0.572	840	0.23	338	1.9	2789	0.182	267	0.17	250
TRACK. WELD.	1	35	1468	0.45	0.011	254	0.002	46	0.018	416	0.002	46	0.001	23
LOADER	1	1	1488	1	0.572	851	0.23	342	1.9	2827	0.182	271	0.17	253

WELDER	1	35	1488	0.45	0 011	258	0.002	47	0.018	422	0.002	47	0.001	23
PICKUP	1	1	1488	1	0.016	24	0.0017	3	0.0017	3	0.0001	.0	0.0003	0
LOADER	1	1	4968	1	0.572	2842	0.23	1143	1.9	9439	0.182	904	0.17	845
BACKHOE	1	79	5400	0.465	0.015	2976	0.003	595	0.022	4364	0.002	397	0.001	198
DUMP TRK.	2	1	5400	1	0.675	7290	0.15	1620	1.7	18360	0.143	1544	0.14	1512
PICKUP	1	1	5400	1	0.016	86	0.0017	9	0.0017	9	0.0001	1	0.0003	2
			Total			154090.5		36231.96		382013.9		32180.35		30014.07

EQUIPMENT APP F-12	# USED	RATED H.P	HOURS	LOAD FACTOR	CARBON MONOXIDE EMISSION FACTOR	CARBON MONOXIDE EMISSION RATE lbs	EXHAUST R[illegible] EMISSION FACTOR	EXHAUST R[illegible] EMISSION RATE lbs	NITROGEN OXIDES EMISSION FACTOR	NITROGEN OXIDES EMISSION RATE lbs	SULFUR OXIDES EMISSION FACTOR	SULFUR OXIDES EMISSION RATE lbs	PARTICULATES EMISSION FACTOR	PARTICULATES EMISSION RATE lbs
BULLDOZER	1	356	2317	0.59	0.01	4867	0.002	973	0.021	10220	0.002	973	0.0005	[illegible]
MOTOR GRADER	1	1	2317	1	0.151	350	0.039	90	0.713	1652	0.086	199	0.061	141
SCRAPER	1	1	2317	1	1.25	2896	0.27	626	3.84	8897	0.46	1066	0.41	950
DUMP TRK	[illegible]	1	2317	1	0.675	7820	0.15	1738	1.7	19695	0.143	1657	0.14	1622
PWR. SHOVEL	[illegible]	79	3333	0.465	0.015	1837	0.003	367	0.022	2694	0.002	245	0.001	122
WATER TRK	1	1	3333	1	0.675	2250	0.15	500	1.7	5666	0.143	477	0.14	467
PICKUP	1	1	3333	1	0.016	53	0.0017	6	0.0017	6	0.0001	0	0.0003	1
DUMP TRK	24	1	3333	1	0.675	53995	0.15	11999	1.7	135986	0.143	11439	0.14	11199
ROLLER	1	1	782	1	0.3	235	0.065	51	0.87	680	0.067	52	0.05	39
MOTOR GRADER	1	1	782	1	0.151	118	0.039	30	0.713	558	0.086	67	0.061	48
WATER TRK.	1	1	391	1	0.675	264	0.15	59	1.7	665	0.143	56	0.14	[illegible]
TUNNEL MACH	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
CONVEYOR	1	450	0	0.695	0.02	0	0.003	0	0.022	0	0.002	0	0.0015	0
VENTILATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
JACKS	1	1	0	1	0.675	0	0.15	0	1.7	0	0.143	0	0.14	0
CRANE	1	194	0	0.43	0.009	0	0.003	0	0.023	0	0.002	0	0.0015	0
GENERATOR	1	22	0	0.74	0.011	0	0.002	0	0.018	0	0.002	0	0.001	0
DRILL RIG	1	209	945	0.75	0.02	2963	0.003	444	0.024	3555	0.002	296	0.0015	222
TANK TRK.	1	1	945	1	0.675	638	0.15	142	1.7	1607	0.143	135	0.14	132
PUMP	1	22	945	0.74	0.011	169	0.002	31	0.018	277	0.002	31	0.001	15
CRANE	1	194	9278	0.43	0.009	6966	0.003	2322	0.023	17801	0.002	1548	0.0015	1161
CONCRETE TRK.	4	1	9278	1	0.675	25051	0.15	5567	1.7	63090	0.143	5307	0.14	5196
CONCRETE PUMP	1	23	9278	0.74	0.011	1737	0.002	316	0.018	2842	0.002	316	0.001	158
PICKUP	1	1	9278	1	0.016	148	0.0017	16	0.0017	16	0.0001	1	0.0003	3
CRANE	2	194	107	0.43	0.009	161	0.003	54	0.023	411	0.002	36	0.0015	27
SPECIAL TRK.	1	161	107	0.62	0.02	214	0.003	32	0.024	256	0.002	21	0.0015	16
PWR. TOOLS	1	5	1612	1	0	0	0	0	0	0	0	0	0	0
PWR. TOOLS	1	5	3626	1	0	0	0	0	0	0	0	0	0	0
PILE HMR.	1	43	5597	0.505	0.013	1580	0.003	365	0.031	3768	0.002	243	0.0015	182
CRANE	1	194	5597	0.43	0.009	4202	0.003	1401	0.023	10739	0.002	934	0.0015	700
AIR COMPRES.	1	37	5597	0.48	0.011	1093	0.002	199	0.018	1789	0.002	199	0.001	99
FRK.LFT.175HP	1	1	5597	1	0.52	2910	0.17	951	1.54	8619	0	0	0.093	521
PICKUP	1	1	2125	1	0.016	34	0.0017	4	0.0017	4	0.0001	0	0.0003	1
BACKHOE	1	79	2125	0.465	0.015	1171	0.003	234	0.022	1717	0.002	156	0.001	78
DUMP TRK.	1	1	2125	1	0.675	1434	0.15	319	1.7	3613	0.143	304	0.14	298
PICKUP	1	1	358	1	0.016	6	0.0017	1	0.0017	1	0.0001	0	0.0003	0
WELDER	1	35	358	0.45	0.011	62	0.002	11	0.018	101	0.002	11	0.001	6
PICKUP	1	1	934	1	0.016	15	0.0017	2	0.0017	2	0.0001	0	0.0003	0
MOTOR GRADER	3	1	1060	1	0.151	480	0.039	124	0.713	2267	0.086	273	0.061	194
PAVER	1	130	1060	0.62	0.01	854	0.002	171	0.022	1880	0.002	171	0.001	85
ROLLERS	5	1	1060	1	0.3	1590	0.065	345	0.87	4611	0.067	355	0.05	265
DUMP TRK.	21	1	1060	1	0.675	15026	0.15	3339	1.7	37842	0.143	3183	0.14	3116
MOTOR GRADER	1	1	2426	1	0.151	366	0.039	95	0.713	1730	0.086	209	0.061	148
LOADER	1	1	2426	1	0.572	1388	0.23	558	1.9	4609	0.182	442	0.17	412
DUMP TRK.	4	1	2426	1	0.675	6550	0.15	1456	1.7	16497	0.143	1388	0.14	1359
PICKUP	1	1	125	1	0.016	2	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	125	1	1.25	156	0.27	34	3.84	480	0.46	58	0.41	51
LOADER	1	1	125	1	0.572	72	0.23	29	1.9	238	0.182	23	0.17	21
ROLLER	1	1	125	1	0.3	38	0.065	8	0.87	109	0.067	8	0.05	6
DUMP TRK.	14	1	125	1	0.675	1181	0.15	263	1.7	2975	0.143	250	0.14	245
PICKUP	1	1	251	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
TAMPER LINER	1	1	251	1	1.25	314	0.27	68	3.84	964	0.46	115	0.41	103
LOADER	1	1	251	1	0.572	144	0.23	58	1.9	477	0.182	46	0.17	43
BALLAST PROF.	1	1	251	1	1.25	314	0.27	68	3.84	964	0.46	115	0.41	103
DUMP TRK.	14	1	251	1	0.675	2372	0.15	527	1.7	5974	0.143	503	0.14	492
PICKUP	1	1	263	1	0.016	4	0.0017	0	0.0017	0	0.0001	0	0.0003	0
BACKHOE	1	79	263	0.465	0.015	145	0.003	29	0.022	213	0.002	19	0.001	10
LOADER	1	1	1444	1	0.572	826	0.23	332	1.9	2744	0.182	263	0.17	245
TRACK. WELD.	1	35	1444	0.45	0.011	250	0.002	45	0.018	409	0.002	45	0.001	23
LOADER	1	1	1453	1	0.572	831	0.23	334	1.9	2761	0.182	264	0.17	247

WELDER	1	35	1453	0.45	0.011	252	0.002	46	0.018	412	0.002	46	0.001	23
PICKUP	1	1	1453	1	0.016	23	0.0017	2	0.0017	2	0.0001	0	0.0003	0
LOADER	1	1	4848	1	0.572	2773	0.23	1115	1.9	9211	0.182	882	0.17	824
BACKHOE	1	79	5310	0.465	0.015	2926	0.003	585	0.022	4291	0.002	390	0.001	195
DUMP TRK.	2	1	5310	1	0.675	7169	0.15	1593	1.7	18054	0.143	1519	0.14	1487
PICKUP	1	1	5310	1	0.016	85	0.0017	9	0.0017	9	0.0001	1	0.0003	2
				Total		171370.9		40079.63		426648.5		36337.69		33401.84

Attachment B

Regional VMT Data and Mileage Growth Factors

MTC
METROPOLITAN
TRANSPORTATION
COMMISSION

MEMORANDUM

JOSEPH P. BORT METROCENTER
101 EIGHTH STREET
OAKLAND, CA 94607-4700
510/464-7700•TDD/TTY 510/464-7769
FAX 510/464-7848

TO: Greg Noblet, OGDEN Environmental
FROM: Miguel Iglesias, MTC
RE.: BART-SFO VMT ESTIMATES

October 18, 1993

Here are the regional VMT estimates you requested (also included is VHT, in case you need it):

Alternative:	VMT	VHT
1990 No-Action	8,472,007	329,913
1990 LPA	8,442,891	328,013
2010 No-Action	10,364,797	512,133
2010 LPA	10,332,100	505,188
2010 TSM	10,318,345	503,104

cc: CPurvis, RWest

Parsons Brinckerhoff
303 Second Street
Suite 700 North
San Francisco, CA 94107-1317
415-243-4600
Fax: 415-243-9501

December 8, 1993

Rod Jeung
Ogden Environmental
221 Main Street, Suite 1400
San Francisco, CA 94105

Subject: BART-SFO RDEIR
Growth factors for use in deriving volumes and VMT for intermediate years.

Dear ~~Mr. Jeung:~~ Rod

As requested, please find attached Parsons Brinckerhoff's estimated for the amount of growth to assume for each of the three intermediate years (1993, 1998, and 2000). These growth factors should be used to derive travel volumes and VMT.

The percentages shown represent the amount of the total 1990 to 2010 growth that should be applied to each year. They do not represent the gross total growth. Thus, for instance, the 100 percent shown for 2010 indicates that 100 percent of the growth between 1990 and 2010 has occurred by 2010, not that there is actually a 100 percent growth in travel.

Please call at your convenience if you have any questions on this matter.

Thank you.

Respectfully,

PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.

Gregory L. Kipp

Gregory L. Kipp
Senior Transportation Planner

cc: Alan Lee, BART
Tom Lu, PBQ&D
Ross Maxwell, PBQ&D

BART-SFO RDEIR 12/08/93
GROWTH FACTORS TO DERIVE TRAFFIC VOLUMES/MILEAGE PBQ&D
FOR EACH PROJECT ANALYSIS YEAR

	STUDY AREA TRIP PATTERNS					PERCENT OF
YEAR	I-I	I-X	X-I	X-X	TOTAL	TOTAL GROWTH 1990-2010
1990	932,151	306,882	312,279	14,247,675	15,798,987	0.00%
1993	972,593	318,273	318,371	14,954,586	16,563,823	17.35%
1998	1,042,998	332,775	333,837	16,749,309	18,458,920	60.33%
2000	1,067,369	337,795	339,191	17,370,560	19,114,914	75.20%
2010	1,107,987	346,161	348,114	18,405,977	20,208,239	100.00%

LEGEND

I-I = Internal to Internal trips
I-X = Internal to External trips
X-I = External to Internal trips
X-X = External to External trips

NOTES

1990 and 2010 volumes from MTC trip tables.
Intermediate year volumes based on ABAG projections provided for 5-year intervals, plus field traffic counts for 1993.

Attachment C

Top 20 Roadway Intersections by EPA Ranking Procedure

KORVE ENGR OAKLAND FAX NO. 5106549220 P.02

Korve Engineering

MEMORANDUM

TO: Carolyn Atwood, Ogden

FROM: Luba Wyznyckyj, KORVE

DATE: April 12, 1994

SUBJECT: BART-SFO: Intersection Ranking for AQ Analysis 194018X0

Initial results of the intersection ranking for 1998 AM and PM peak hour conditions for the six project alternatives. A formal memo will be transmitted to you before the end of the week.

1. We ranked all of the intersections based on 1998 total volumes, and summarized the top 20 intersections for each alternative.

2. We inserted the LOS and v/c ratio for each intersection, and highlighted in bold the intersections with the highest v/c ratios.

3. The existing air quality analysis intersections were shaded in.

As per the criteria in the Section 3 - Intersection Selection Procedure, the top three intersections with the highest volumes, and the top three intersections with the highest v/c ratio/LOS for each analysis alternative have been included in your list of analysis intersections.

The one unsignalized intersection (#31) in the list of 20, indicates a LOS E for the left turn onto the minor street. I don't think that this intersection is critical, as the through movements operate at acceptable levels.

AM PEAK HOUR
INTERSECTION RANKING (1998 Conditions)

	ALT. LPA				ALT. I				ALT. II				ALT. III				ALT. IV				ALT. V			
Rank	Int. No.	Volume	LOS	v/c	Int. No.	Volume	LOS	v/c	Int. No.	Volume	LOS	v/c	Int. No.	Volume	LOS	v/c	Int. No.	Volume	LOS	v/c	Int. No.	Volume	LOS	v/c
1	72	5,864	F	1.00	72	5,548	E	0.95	72	5,623	E	0.98	72	5,711	F	1.01	72	5,073	E	0.80	72	5,032	D	0.82
2	34	4,660	B	0.62	25	4,284	C	0.72	25	4,216	D	0.83	34	4,554	B	0.60	25	4,160	B	0.64	34	4,188	A	0.58
3	25	4,100	B	0.64	23	4,121	D	0.81	34	4,114	A	0.56	23	4,210	D	0.82	34	4,131	A	0.57	25	4,168	B	0.65
4	23	4,025	C	0.77	34	4,069	A	0.53	25	4,081	B	0.65	40	4,002	A	0.36	40	3,841	A	0.31	23	4,032	C	0.79
5	40	3,989	A	0.49	40	3,651	A	0.45	40	3,610	A	0.46	26	3,700	A	0.49	45	3,610	C	0.70	45	4,015	C	0.77
6	45	3,536	B	0.61	45	3,352	A	0.57	45	3,463	B	0.60	45	3,474	B	0.68	29	3,410	A	0.55	40	3,760	A	0.29
7	28	3,354	A	0.55	29	3,320	A	0.54	29	3,290	A	0.54	29	3,447	A	0.56	41	3,142	A	0.31	29	3,424	A	0.56
8	41	3,197	A	0.37	41	2,918	A	0.30	41	2,936	A	0.28	41	3,113	A	0.36	69	2,982	A	0.41	48	3,061	B	0.63
9	69	2,891	A	0.37	24	2,848	A	0.54	69	2,917	A	0.37	69	3,090	A	0.39	24	2,904	A	0.55	64	3,047	A	0.40
10	24	2,843	A	0.54	28	2,831	A	0.50	24	2,883	A	0.54	28	2,921	A	0.51	28	2,838	A	0.51	41	3,035	A	0.29
11	28	2,816	A	0.50	69	2,802	A	0.38	28	2,788	A	0.50	24	2,918	B	0.63	3	2,798	A	0.48	69	2,948	A	0.41
12	3	2,789	A	0.51	67	2,616	A	0.27	3	2,774	A	0.49	21	2,714	C	0.70	48	2,668	A	0.52	24	2,901	A	0.55
13	67	2,708	A	0.28	31	2,522		C	67	2,685	A	0.28	67	2,681	A	0.28	44	2,658	A	0.50	28	2,861	A	0.50
14	65	2,572	A	0.28	65	2,438	A	0.25	31	2,501		C	3	2,670	A	0.48	67	2,599	A	0.27	44	2,825	A	0.54
15	31	2,509		C	44	2,381	A	0.44	65	2,477	A	0.26	31	2,588		C	31	2,558		C	3	2,782	A	0.52
16	56	2,459	A	0.50	26	2,301	A	0.39	44	2,429	A	0.44	65	2,524	A	0.27	65	2,534	A	0.27	67	2,640	A	0.28
17	81	2,457	A	0.59	64	2,251	A	0.36	81	2,335	A	0.54	44	2,441	A	0.46	13	2,424	B	0.67	31	2,574		C
18	4	2,439	A	0.36	81	2,241	A	0.51	4	2,331	A	0.48	64	2,356	A	0.37	4	2,412	A	0.38	65	2,532	A	0.27
19	64	2,387	A	0.39	48	2,132	B	0.61	64	2,311	A	0.38	81	2,322	A	0.55	64	2,389	A	0.40	13	2,471	B	0.65
20	44	2,353	A	0.45	82	2,126	A	0.39	48	2,207	B	0.63	48	2,260	B	0.64	81	2,375	A	0.55	4	2,462	A	0.37

Note: Intersection #31 is unsignalized. LOS is for the southbound left turn from El Camino Real onto eastbound Noor

72 = ECR Millbrae
34 ECR/Sneath
25 ECR/West Borel
23 Junipero Serra/West
40 ECR / 380 W
45
29
41

PM PEAK HOUR
INTERSECTION RANKING (1998 Conditions)

	ALT LPA				ALT I				ALT II				ALT III				ALT IV				ALT V			
Rank	Int. No.	Volume	LOS	v/c	Int. No.	Volume	LOS	v/c	Int. No.	Volume	LOS	v/c	Int. No.	Volume	LOS	v/c	Int. No.	Volume	LOS	v/c	Int. No.	Volume	LOS	v/c
1	34	6,701	E	0.94	72	6,563	E	0.93	72	6,644	E	0.93	72	6,694	E	0.93	34	6,259	D	0.85	34	6,138	D	0.85
2	72	6,685	E	0.94	34	6,494	D	0.87	34	6,275	D	0.85	34	6,671	E	0.90	72	5,973	D	0.85	72	6,020	D	0.86
3	23	5,537	E	0.92	25	5,722	D	0.84	23	5,596	E	0.82	23	5,641	E	0.95	23	5,570	E	0.98	23	5,519	E	0.82
4	25	5,303	C	0.73	23	5,545	E	0.94	25	5,352	C	0.74	25	4,966	C	0.78	25	5,369	C	0.73	25	5,357	C	0.74
5	45	4,853	C	0.76	29	4,892	C	0.75	29	4,861	C	0.72	45	4,656	C	0.77	45	4,780	D	0.81	45	4,876	D	0.84
6	29	4,667	C	0.71	40	4,664	A	0.44	45	4,603	C	0.78	29	4,629	C	0.73	29	4,635	C	0.72	29	4,643	C	0.72
7	40	4,317	A	0.44	45	4,523	C	0.74	40	4,293	A	0.44	40	4,281	A	0.44	40	4,241	A	0.42	40	4,178	A	0.41
8	41	4,160	A	0.48	28	4,251	C	0.72	28	4,064	C	0.71	41	4,160	A	0.48	41	4,108	A	0.48	28	4,116	C	0.72
9	28	4,057	C	0.71	41	3,993	A	0.46	41	4,060	A	0.47	28	4,108	D	0.81	28	4,104	C	0.72	41	4,103	A	0.49
10	69	3,707	A	0.45	31	3,850		E	69	3,737	A	0.46	69	3,879	A	0.53	69	3,914	C	0.79	69	4,050	D	0.82
11	64	3,622	A	0.57	69	3,658	A	0.46	31	3,599		E	21	3,848	C	0.77	64	3,658	B	0.60	64	3,631	A	0.59
12	31	3,481		E	64	3,511	A	0.65	64	3,595	A	0.65	65	3,759	A	0.35	31	3,529		E	31	3,541		E
13	4	3,452	B	0.65	67	3,349	A	0.41	4	3,405	B	0.70	31	3,544		E	4	3,474	B	0.68	4	3,498	B	0.67
14	65	3,444	A	0.36	65	3,313	A	0.34	67	3,364	A	0.42	64	3,522	A	0.55	65	3,432	A	0.37	65	3,441	A	0.36
15	67	3,431	A	0.41	24	3,184	A	0.59	65	3,340	A	0.35	67	3,395	A	0.41	67	3,303	A	0.38	67	3,332	A	0.39
16	24	3,260	B	0.61	54	2,955	A	0.54	24	3,273	B	0.60	4	3,219	B	0.67	24	3,291	B	0.62	3	3,240	B	0.67
17	3	3,368	B	0.65	21	2,946	A	0.41	3	3,219	B	0.64	24	3,114	B	0.62	3	3,167	B	0.66	24	3,235	B	0.60
18	54	2,995	A	0.56	3	2,793	A	0.66	54	2,928	A	0.59	3	3,017	B	0.61	48	3,056	A	0.55	48	3,170	B	0.64
19	44	2,834	A	0.47	44	2,777	A	0.47	44	2,611	A	0.46	54	2,891	A	0.58	54	3,002	A	0.57	44	2,998	A	0.50
20	21	2,832	A	0.51	26	2,677	A	0.36	81	2,689	A	0.51	44	2,858	A	0.48	21	2,901	A	0.52	21	2,932	A	0.53

Note: Intersection #31 is unsignalized. LOS is for the southbound left turn from El Camino Real onto eastbound Noor.

28 = ECR/ORANGE (D = ALT III

~~31 = ECR/NOOR~~ (E = LPA, ALT IV, ALT V)

April 12, 1994

Attachment D

Alternative-specific Intersection Traffic and Geometry Conditions

Table D-1
Proposed Project - Locally Preferred Alternative (LPA)
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model	Other Intersections	
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	incorporated into Analysis	Notes
El Camino Real	Hickey Blvd.	S	0.51	A	2,759	0.65	B	3,168	CALINE4	none	
Rollingwood Dr./ I-280 SB ramps	Sneath Ln.	S	0.84	D	2,457	0.68	B	2,738	CAL3QHC	none	
Mission Rd.	Evergreen Dr.	A	-	B	988	-	A	895	CALINE4	none	
Mission Rd.	New street	A	-	F/C	1,563	-	D/A	1,261	CALINE4	none	
El Camino Real	New street	S	0.62	B	2,342	0.51	A	2,781	CALINE4	none	
Mission Rd.	Grand Av.	A	-	B	1,284	-	B	1,179	CALINE4	none	
Chestnut Av.	Grand Av.	S	0.74	C	1,911	0.67	B	1,894	CALINE4	none	
Mission Rd.	Oak Av.	U	-	A/A	631	-	A/A	499	CAL3QHC	none	
El Camino Real	Arroyo Dr.	S	0.32	A	2,306	0.44	A	2,832	CAL3QHC	El Camino Real - Westborough Blvd. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
Junipero Serra Blvd.	Westborough Blvd.	S	0.77	C	4,025	0.92	E	5,537	CAL3QHC	none	
El Camino Real	Chestnut Av./ Westborough Blvd.	S	0.64	B	4,100	0.73	C	5,303	CAL3QHC	El Camino Real - Arroyo Dr. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
El Camino Real	So. Spruce Av.	S	0.55	A	3,354	0.71	C	4,567	CAL3QHC	none	
El Camino Real	Sneath Ln.	S	0.62	B	4,660	0.83	D	6,701	CAL3QHC	none	
Huntington Av.	Sneath Ln.	S	0.43	A	1,526	0.61	B	2,139	CALINE4	none	Four-way, signalized intersection. Tanforan BART station to immediate east.
El Camino Real	San Bruno Av.	S	0.43	A	3,536	0.64	B	4,653	CAL3QHC	none	Existing geometry assumed in 1993. Planned improvements incorporated in 1998, 2000, and 2010.
San Mateo Av.	San Bruno Av.	S	0.70	B	2,304	0.64	B	2,463	CAL3QHC	Huntington Av. - San Bruno Av. 2nd Av. - San Bruno Av. San Mateo Av. - Huntington Av.	

Table D-1
Proposed Project - Locally Preferred Alternative (LPA)
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model	Other Intersections	
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	incorporated into Analysis	Notes
2nd Av	San Bruno Av.	U	-	D/C	1,941	-	E/B	2,176	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. San Mateo Av. - Huntington Av.	
San Mateo Av.	Huntington Av.	U	-	C/A	1,040	-	D/D	1,288	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. 2nd Av. - San Bruno Av.	
Huntington Av.	Angus Av.	A	-	B	917	-	C	1,187	CALINE4	none	
El Camino Real	Center St.	S	0.37	A	2,892	0.45	A	3,707	CALINE4	none	
El Camino Real	Millbrae Av.	S	0.97	E	5,664	1.05	F	6,685	CAL3QHC	none	Existing geometry assumed in 1993. Planned improvements (Millbrae Av. grade separation) incorporated into intersection geometry in 1998, 2000, and 2010. Planned improvements not incorporated into traffic volumes.
Rollins Rd.	Millbrae Av.										
El Camino Real	Murchison Dr.										
California Dr.	Broadway										

Notes:

1) Signal control: S–signalized; U–unsignalized (stop sign on minor road only); and A–all-way stop.

2) V/C is volume to capacity ratio. V/C is not calculated for unsignalized or all-way stop intersections.

3) LOS is intersection level of service. A single value is determined at signalized and all-way stop intersections. At unsignalized intersections, LOS is determined for each critical movement (left turns from the major street, all movements from the minor street); the first value given is the LOS for the worst-case critical movement, and the second value is the LOS for the dominant (largest volume) critical movement.

Table D-2
Alternative I – No Build Alternative
Intersection Traffic and Geometry Conditions

N/S Street	E/W Street	Signal Control	1998 Peak-Hour Traffic Conditions AM V/C	AM LOS	AM Volume (vph)	PM V/C	PM LOS	PM Volume (vph)	Model Used	Other Intersections incorporated into Analysis	Notes
El Camino Real	Hickey Blvd.	S	0.41	A	2.096	0.56	A	2.793	CALINE4	none	
Rollingwood Dr./ I-280 SB ramps	Sneath Ln.	S	0.74	C	2,241	0.65	B	2,653	CAL3QHC	none	
Mission Rd.	Evergreen Dr.	A	-	C	1,416	-	B	1,074	CALINE4	none	
Mission Rd.	New street	na	na	na	na	na	na	na	na	na	Intersection does not exist under the No Build alternative.
El Camino Real	New street	na	na	na	na	na	na	na	na	na	Intersection does not exist under the No Build alternative.
Mission Rd.	Grand Av.	A						1,248	CALINE4	none	
Chestnut Av.	Grand Av.	S	0.69	B	1,824	0.92	E	2,176	CALINE4	none	
Mission Rd.	Oak Av.	U	-	B/B	978	-	A/A	843	CAL3QHC	none	
El Camino Real	Arroyo Dr.	S	0.26	A	2,037	0.41	A	2,946	CAL3QHC	El Camino Real - Westborough Blvd. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
Junipero Serra Blvd.	Westborough Blvd.	S	0.81	D	4,121	0.94	E	5,545	CAL3QHC	none	
El Camino Real	Chestnut Av./ Westborough Blvd.	S	0.72	C	4,284	0.84	D	5,722	CAL3QHC	El Camino Real - Arroyo Dr. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
El Camino Real	So. Spruce Av.	S	0.54	A	3,320	0.75	C	4,892	CAL3QHC	none	
El Camino Real	Sneath Ln.	S	0.53	A	4,069	0.78	C	6,494	CAL3QHC	none	
Huntington Av.	Sneath Ln.	A	-	A	911	-	C	1,690	CALINE4	none	
El Camino Real	San Bruno Av.	S	?	?	?	0.74	C	4,523	CAL3QHC	none	
San Mateo Av.	San Bruno Av.	S	0.61	B	2,132	0.63	B	2,396	CAL3QHC	Huntington Av. - San Bruno Av. 2nd Av. - San Bruno Av. San Mateo Av. - Huntington Av.	

Table D-2
Alternative I – No Build Alternative
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions							
		Signal	AM			PM			Model	Other Intersections	
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	incorporated into Analysis	Notes
2nd Av.	San Bruno Av.	U	-	D/B	1,809	-	E/B	2,119	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. San Mateo Av. - Huntington Av.	
San Mateo Av.	Huntington Av.	U	-	B/B	1,036	-	D/D	1,122	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. 2nd Av. - San Bruno Av.	
Huntington Av.	Angus Av.	A	-	B	821	-	D	1,146	CALINE4	none	
El Camino Real	Center St.	S	0.36	A	2,802	0.45	A	3,658	CALINE4	none	
El Camino Real	Millbrae Av.	S	0.98	E	5,548	1.05	F	6,563	CAL3QHC	none	
Rollins Rd.	Millbrae Av.	S	0.77	C	4,693	0.64	B	5,155	CAL3QHC	none	
El Camino Real	Murchison Dr.	S	0.62	B	3,178	0.64	B	3,669	CAL3QHC	El Camino Real - California Dr.	
California Dr.	Broadway	S	0.82	D	2,894	0.87	D	2,965	CAL3QHC	none	

Notes:

1) Signal control: S–signalized; U–unsignalized (stop sign on minor road only); and A–all-way stop.

2) V/C is volume to capacity ratio. V/C is not calculated for unsignalized or all-way stop intersections.

3) LOS is intersection level of service. A single value is determined at signalized and all-way stop intersections. At unsignalized intersections, LOS is determined for each critical movement (left turns from the major street, all movements from the minor street); the first value given is the LOS for the worst-case critical movement, and the second value is the LOS for the dominant (largest volume) critical movement.

Table D-3
Alternative II – Transportation Systems Management (TSM)
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model	Other Intersections	
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	incorporated into Analysis	Notes
El Camino Real	Hickey Blvd.	S	0.49	A	2,774	0.64	B	3,189	CALINE4	none	
Rollingwood Dr./ I-280 SB ramps	Sneath Ln.	S	0.78	C	2,335	0.65	B	2,689	CAL3QHC	none	
Mission Rd.	Evergreen Dr.	A	-	D	1,571	-	C	1,256	CALINE4	none	
Mission Rd.	New street	na	na	na	na	na	na	na	na	na	Intersection does not exist under the TSM alternative.
El Camino Real	New street	na	na	na	na	na	na	na	na	na	Intersection does not exist under the TSM alternative.
Mission Rd.	Grand Av.	A	-	C	1,436	-	B	1,329	CALINE4	none	
Chestnut Av.	Grand Av.	S	0.65	B	1,798	0.90	E	2,206	CALINE4	none	
Mission Rd.	Oak Av.	U	-	A/A	945	-	B/B	776	CAL3QHC	none	
El Camino Real	Arroyo Dr.	S	0.28	A	1,764	0.41	A	2,480	CAL3QHC	El Camino Real - Westborough Blvd. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
Junipero Serra Blvd.	Westborough Blvd.	S	0.83	D	4,216	0.92	E	5,598	CAL3QHC	none	
El Camino Real	Chestnut Av./ Westborough Blvd.	S	0.65	B	4,081	0.74	C	5,362	CAL3QHC	El Camino Real - Arroyo Dr. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
El Camino Real	So. Spruce Av.	S	0.54	A	3,290	0.72	C	4,661	CAL3QHC	none	
El Camino Real	Sneath Ln.	S	0.56	A	4,114	0.85	D	6,275	CAL3QHC	none	
Huntington Av.	Sneath Ln.	A	-	A	947	-	C	1,591	CALINE4	none	
El Camino Real	San Bruno Av.	S	0.60	B	3,483	0.76	C	4,603	CAL3QHC	none	
San Mateo Av.	San Bruno Av.	S	0.63	B	2,207	0.66	B	2,470	CAL3QHC	Huntington Av. - San Bruno Av. 2nd Av. - San Bruno Av. San Mateo Av. - Huntington Av.	

Table D-3
Alternative II – Transportation Systems Management (TSM)
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model	Other Intersections	
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	incorporated into Analysis	Notes
2nd Av.	San Bruno Av.	U	-	D/B	1,851	-	E/B	2,219	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. San Mateo Av. - Huntington Av.	
San Mateo Av.	Huntington Av.	U	-	C/A	944	-	D/D	1,252	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. 2nd Av. - San Bruno Av.	
Huntington Av.	Angus Av.	A	-	B	873	-	?	?	CALINE4	none	
El Camino Real	Center St.	S	0.37	A	2,917	0.46	A	3,737	CALINE4	none	
El Camino Real	Millbrae Av.	S	0.93	E	5,523	1.05	F	6,644	CAL3QHC	none	
Rollins Rd.	Millbrae Av.	S	0.80	C	4,837	0.66	B	5,300	CAL3QHC	none	
El Camino Real	Murchison Dr.	S	0.71	C	3,577	0.70	B	4,084	CAL3QHC	El Camino Real - California Dr.	
California Dr.	Broadway	S	0.82	D	2,844	0.88	D	2,988	CAL3QHC	none	

Notes:

1) Signal control: S–signalized; U–unsignalized (stop sign on minor road only); and A–all-way stop.

2) V/C is volume to capacity ratio. V/C is not calculated for unsignalized or all-way stop intersections.

3) LOS is intersection level of service. A single value is determined at signalized and all-way stop intersections. At unsignalized intersections, LOS is determined for each critical movement (left turns from the major street, all movements from the minor street); the first value given is the LOS for the worst-case critical movement, and the second value is the LOS for the dominant (largest volume) critical movement.

Table D-4
Alternative III - Bart to Airport Intermodal (Base Case)
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model	Other Intersections	
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	incorporated into Analysis	Notes
El Camino Real	Hickey Blvd.	S	0.47	A	2,652	0.59	A	2,908	CALINE4	none	
Rollingwood Dr./ I-280 SB ramps	Sneath Ln.	S	0.78	C	2,332	0.69	B	2,703	CAL3QHC	none	
Mission Rd.	Evergreen Dr.	A	-	C	1,455	-	B	1,137	CALINE4	none	
Mission Rd.	New street	na	na	na	na	na	na	na	na	na	Intersection does not exist under Alternative III.
El Camino Real	New street	na	na	na	na	na	na	na	na	na	Intersection does not exist under Alternative III.
Mission Rd.	Grand Av.	A	-	C	1,508	-	C	1,420	CALINE4	none	
Chestnut Av.	Grand Av.	S	0.66	B	1,797	0.86	D	2,200	CALINE4	none	
Mission Rd.	Oak Av./ Oak Av. Extension	S	0.56	A	1,982	0.67	B	2,309	CAL3QHC	El Camino Real - Arroyo Dr. El Camino Real - Westborough Blvd. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	Four-way, signalized intersection; incorporates Oak Av. extension.
El Camino Real	Oak Av. Extension/ Arroyo Dr.	S	0.73	C	2,514	0.89	D	3,843	CAL3QHC	El Camino Real - Westborough Blvd. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd. Mission Rd. - Oak Av.	Four-way, signalized intersection; incorporates Oak Av. extension.
Junipero Serra Blvd.	Westborough Blvd.	S	0.82	D	4,210	0.95	E	5,641	CAL3QHC	none	
El Camino Real	Chestnut Av./ Westborough Blvd.	S	0.49	A	3,700	0.78	C	4,966	CAL3QHC	El Camino Real - Arroyo Dr. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd. Mission Rd. - Oak Av.	
El Camino Real	So. Spruce Av.	S	0.56	A	3,447	0.73	C	4,629	CAL3QHC	none	
El Camino Real	Sneath Ln.	S	0.60	B	4,554	0.90	E	6,571	CAL3QHC	none	
Huntington Av.	Sneath Ln.	S	0.32	A	1,325	0.57	A	1,966	CALINE4	none	Four-way, signalized intersection with Tanforan BART station to immediate east.

Table D-4
Alternative III - Bart to Airport Intermodal (Base Case)
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model	Other Intersections	
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	incorporated into Analysis	Notes
El Camino Real	San Bruno Av.	S	0.42	A	3,474	0.65	B	4,656	CAL3QHC	none	Existing geometry assumed in 1993; planned improvements incorporated in 1998, 2000, and 2010.
San Mateo Av.	San Bruno Av.	S	0.64	B	2,260	0.67	B	2,499	CAL3QHC	Huntington Av. - San Bruno Av. 2nd Av. - San Bruno Av. San Mateo Av. - Huntington Av.	
2nd Av.	San Bruno Av.	U	-	D/B	1,893	-	E/B	2,229	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. San Mateo Av. - Huntington Av.	
San Mateo Av.	Huntington Av.	U	-	B/A	998	-	D/D	1,276	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. 2nd Av. - San Bruno Av.	
Huntington Av.	Angus Av.	A	-	B	908	-	D	1,172	CALINE4	none	
El Camino Real	Center St.	S	0.39	A	3,090	0.53	A	3,879	CALINE4	none	
El Camino Real	Millbrae Av.	S	0.96	E	5,711	1.05	F	6,694	CAL3QHC	none	Existing geometry assumed in 1993. Planned improvements (Millbrae Av. grade separation) incorporated into intersection geometry in 1998, 2000, and 2010. Planned improvements not incorporated into traffic volumes.
Rollins Rd.	Millbrae Av.										
El Camino Real	Murchison Dr.										
California Dr.	Broadway										

Notes:

1) Signal control: S–signalized; U–unsignalized (stop sign on minor road only); and A–all-way stop.

2) V/C is volume to capacity ratio. V/C is not calculated for unsignalized or all-way stop intersections.

3) LOS is intersection level of service. A single value is determined at signalized and all-way stop intersections. At unsignalized intersections, LOS is determined for each critical movement (left turns from the major street, all movements from the minor street); the first value given is the LOS for the worst-case critical movement, and the second value is the LOS for the dominant (largest volume) critical movement.

Table D-5
Alternative IV – Airport Aerial East of Highway 101
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
			AM			PM					
N/S Street	E/W Street	Signal Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Model Used	Other Intersections incorporated into Analysis	Notes
El Camino Real	Hickey Blvd.	S	0.18	A	2,798	0.66	B	3,167	CALINE4	none	
Rollingwood Dr./ I-280 SB ramps	Sneath Ln.	S	0.76	C	2,375	0.67	B	2,716	CAL3QHC	none	
Mission Rd.	Evergreen Dr.	A	-	B	986	-	A	894	CALINE4	none	
Mission Rd.	New street	A	-	C	1,585	-	B	1,274	CALINE4	none	
El Camino Real	New street	S	0.67	B	2,424	0.55	A	2,849	CALINE4	none	
Mission Rd.	Grand Av.	A			1,293			1,196	CALINE4	none	
Chestnut Av.	Grand Av.	S	0.67	B	1,902	0.93	E	2,311	CALINE4	none	
Mission Rd.	Oak Av.	U	-	A/A	635	-	A/A	498	CAL3QHC	none	
El Camino Real	Oak Av. Extension/ Arroyo Dr.	S	0.31	A	2,360	0.45	A	2,901	CAL3QHC	El Camino Real - Westborough Blvd. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
Junipero Serra Blvd.	Westborough Blvd.	S	0.80	C	4,091	0.93	E	5,570	CAL3QHC	none	
El Camino Real	Chestnut Av./ Westborough Blvd.	S	0.64	B	4,160	0.73	C	5,369	CAL3QHC	El Camino Real - Arroyo Dr. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
El Camino Real	So. Spruce Av.	S	0.55	A	3,411	0.72	C	4,635	CAL3QHC	none	
El Camino Real	Sneath Ln.	S	0.57	A	4,151	0.85	D	6,259	CAL3QHC	none	
Huntington Av.	Sneath Ln.	A	-	A	1,010	-	C	1,655	CALINE4	none	
El Camino Real	San Bruno Av.	S	0.49	A	3,810	0.68	B	4,780	CAL3QHC	none	Existing geometry assumed in 1993; planned improvements incorporated in 1998, 2000, and 2010.
San Mateo Av.	San Bruno Av.	S	0.63	B	2,669	0.64	B	3,056	CAL3QHC	Huntington Av. - San Bruno Av. 2nd Av. - San Bruno Av. San Mateo Av. - Huntington Av.	San Bruno Av. widened.

Table D-5
Alternative IV – Airport Aerial East of Highway 101
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model	Other Intersections	
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	incorporated into Analysis	Notes
2nd Av.	San Bruno Av.	S	0.21	A	1,629	0.30	A	2,095	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. San Mateo Av. - Huntington Av.	San Bruno Av. widened.
San Mateo Av.	Huntington Av.	U	-	C/A	1,037	-	E/A	1,415	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. 2nd Av. - San Bruno Av.	San Bruno Av. widened.
Huntington Av.	Angus Av.	A	-	C	1,059	-	D	1,200	CALINE4	none	
El Camino Real	Center St.	S	0.45	A	2,932	0.77	C	3,914	CALINE4	none	Westbound Center St. approach widened from one to two lanes.
El Camino Real	Millbrae Av.	S	0.86	D	5,073	0.82	D	5,973	CAL3QHC	none	Existing geometry assumed in 1993. Planned improvements (Millbrae Av. grade separation) incorporated into intersection geometry in 1998, 2000, and 2010. Planned improvements not incorporated into traffic volumes.
Rollins Rd.	Millbrae Av.										
El Camino Real	Murchison Dr.										
California Dr.	Broadway										

Notes:

1) Signal control: S–signalized; U–unsignalized (stop sign on minor road only); and A–all-way stop.

2) V/C is volume to capacity ratio. V/C is not calculated for unsignalized or all-way stop intersections.

3) LOS is intersection level of service. A single value is determined at signalized and all-way stop intersections. At unsignalized intersections, LOS is determined for each critical movement (left turns from the major street, all movements from the minor street); the first value given is the LOS for the worst-case critical movement, and the second value is the LOS for the dominant (largest volume) critical movement.

Table D-6
Alternative V – Minimum Length Subway to Millbrae Intermodal
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model	Other Intersections	
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	incorporated into Analysis	Notes
El Camino Real	Hickey Blvd.	S	0.52	A	2,782	0.67	B	3,240	CALINE4	none	
Rollingwood Dr./ I-280 SB ramps	Sneath Ln.	S	0.76	C	2,330	0.68	B	2,716	CAL3QHC	none	
Mission Rd.	Evergreen Dr.	A	-	B	994	-	A	895	CALINE4	none	
Mission Rd.	New street	A	-	C	1,593	-	B	1,274	CALINE4	none	
El Camino Real	New street	S	0.68	B	2,471	0.56	A	2,869	CALINE4	none	
Mission Rd.	Grand Av.	A			1,291			1,181	CALINE4	none	
Chestnut Av.	Grand Av.	S	0.66	B	1,887	0.94	E	2,330	CALINE4	none	
Mission Rd.	Oak Av.	U	-	A/A	628	-	A/A	525	CAL3QHC	none	
El Camino Real	Oak Av. Extension/ Arroyo Dr.	S	0.32	A	2,377	0.46	A	2,932	CAL3QHC	El Camino Real - Westborough Blvd. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
Junipero Serra Blvd.	Westborough Blvd.	S	0.79	C	4,032	0.92	E	5,519	CAL3QHC	none	
El Camino Real	Chestnut Av./ Westborough Blvd.	S	0.65	B	4,168	0.74	C	5,357	CAL3QHC	El Camino Real - Arroyo Dr. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
El Camino Real	So. Spruce Av.	S	0.56	A	3,424	0.72	C	4,643	CAL3QHC	none	
El Camino Real	Sneath Ln.	S	0.58	A	4,186	0.85	D	6,238	CAL3QHC	none	
Huntington Av.	Sneath Ln.	A	-	A	1,021	-	C	1,662	CALINE4	none	
El Camino Real	San Bruno Av.	S	0.54	A	4,015	0.70	B	4,876	CAL3QHC	none	Existing geometry assumed in 1993; planned improvements incorporated in 1998, 2000, and 2010.
San Mateo Av.	San Bruno Av.	S	0.73	C	3,061	0.73	C	3,170	CAL3QHC	Huntington Av. - San Bruno Av. 2nd Av. - San Bruno Av. San Mateo Av. - Huntington Av.	San Bruno Av. widened.

Table D-6
Alternative V – Minimum Length Subway to Millbrae Intermodal
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model	Other Intersections	
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	incorporated into Analysis	Notes
2nd Av.	San Bruno Av.	U	-	D/C	2,142	-	E/B	2,315	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. San Mateo Av. - Huntington Av.	San Bruno Av. widened.
San Mateo Av.	Huntington Av.	U	-	D/A	1,103	-	E/A	1,410	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. 2nd Av. - San Bruno Av.	San Bruno Av. widened.
Huntington Av.	Angus Av.	A	-	C	938	-	D	1,201	CALINE4	none	
El Camino Real	Center St.	S	0.45	A	2,948	0.79	C	4,050	CALINE4	none	Westbound Center St. approach widened
El Camino Real	Millbrae Av.	S	0.78	C	5,032	0.82	D	6,020	CAL3QHC	none	Existing geometry assumed in 1993. Planned improvements (Millbrae Av. grade separation) incorporated into intersection geometry in 1998, 2000, and 2010. Planned improvements not incorporated into traffic volumes.
Rollins Rd.	Millbrae Av.										
El Camino Real	Murchison Dr.										
California Dr.	Broadway										

Notes:

1) Signal control: S–signalized; U–unsignalized (stop sign on minor road only); and A–all-way stop.

2) V/C is volume to capacity ratio. V/C is not calculated for unsignalized or all-way stop intersections.

3) LOS is intersection level of service. A single value is determined at signalized and all-way stop intersections. At unsignalized intersections, LOS is determined for each critical movement (left turns from the major street, all movements from the minor street); the first value given is the LOS for the worst-case critical movement, and the second value is the LOS for the dominant (largest volume) critical movement.

Table D-7
Design Option V-B – Minimum Length Subway to San Bruno
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
			AM			PM					
N/S Street	E/W Street	Signal Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Model Used	Other Intersections incorporated into Analysis	Notes
El Camino Real	Hickey Blvd.	S	0.51	A	2,816	0.65	B	3,159	CALINE4	none	
Rollingwood Dr./ I-280 SB ramps	Sneath Ln.	S	0.76	C	2,379	0.67	B	2,701	CAL3QHC	none	
Mission Rd.	Evergreen Dr.	A	-	B	989	-	A	913	CALINE4	none	
Mission Rd.	New street	U	-	?	1,588	-	?	1,275	CALINE4	none	
El Camino Real	New street	S	0.65	B	2,418	0.53	A	2,810	CALINE4	none	
Mission Rd.	Grand Av.	A	-	B	1,292	-	B	1,203	CALINE4	none	
Chestnut Av.	Grand Av.	S	0.66	B	1,871	0.93	E	2,310	CALINE4	none	
Mission Rd.	Oak Av.	U	-	A/A	651	-	A/A	513	CAL3QHC	none	
El Camino Real	Oak Av. Extension/ Arroyo Dr.	S	0.32	A	2,369	0.45	A	2,872	CAL3QHC	El Camino Real - Westborough Blvd. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
Junipero Serra Blvd.	Westborough Blvd.	S	0.79	C	4,093	0.92	E	5,550	CAL3QHC	none	
El Camino Real	Chestnut Av./ Westborough Blvd.	S	0.65	B	4,167	0.74	C	5,345	CAL3QHC	El Camino Real - Arroyo Dr. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
El Camino Real	So. Spruce Av.	S	0.55	A	3,362	0.72	C	4,642	CAL3QHC	none	
El Camino Real	Sneath Ln.	S	0.56	A	4,108	0.85	D	6,232	CAL3QHC	none	
Huntington Av.	Sneath Ln.	A	-	A	1,026	-	C	1,700	CALINE4	none	
El Camino Real	San Bruno Av.	S	0.49	A	3,836	0.69	B	4,804	CAL3QHC	none	Existing geometry assumed in 1993; planned improvements incorporated in 1998, 2000, and 2010.
San Mateo Av.	San Bruno Av.	S	0.80	C	2,800	0.65	B	2,970	CAL3QHC	Huntington Av. - San Bruno Av. 2nd Av. - San Bruno Av. San Mateo Av. - Huntington Av.	San Bruno Av. widened.

Table D-7
Design Option V-B – Minimum Length Subway to San Bruno
Intersection Traffic and Geometry Conditions

N/S Street	E/W Street	Signal Control	1998 Peak-Hour Traffic Conditions AM V/C	AM LOS	AM Volume (vph)	PM V/C	PM LOS	PM Volume (vph)	Model Used	Other Intersections incorporated into Analysis	Notes
2nd Av.	San Bruno Av.	S	0.24	A	2,026	0.38	A	2,403	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. San Mateo Av. - Huntington Av.	San Bruno Av. widened.
San Mateo Av.	Huntington Av.	U	-	D/A	1,100	-	E/E	1,309	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. 2nd Av. - San Bruno Av.	San Bruno Av. widened.
Huntington Av.	Angus Av.	A	-	C	1,073	-	D	1,313	CALINE4	none	
El Camino Real	Center St.	S	0.37	A	2,948	0.46	A	3,768	CALINE4	none	
El Camino Real	Millbrae Av.	S	0.95	E	5,645	1.06	F	6,698	CAL3QHC	none	Existing geometry assumed in 1993. Planned improvements (Millbrae Av. grade separation) incorporated into intersection geometry in 1998, 2000, and 2010. Planned improvements not incorporated into traffic volumes.
Rollins Rd.	Millbrae Av.										
El Camino Real	Murchison Dr.										
California Dr.	Broadway										

Notes:

1) Signal control: S–signalized; U–unsignalized (stop sign on minor road only); and A–all-way stop.

2) V/C is volume to capacity ratio. V/C is not calculated for unsignalized or all-way stop intersections.

3) LOS is intersection level of service. A single value is determined at signalized and all-way stop intersections. At unsignalized intersections, LOS is determined for each critical movement (left turns from the major street, all movements from the minor street); the first value given is the LOS for the worst-case critical movement, and the second value is the LOS for the dominant (largest volume) critical movement.

Table D-8
Alternative VI – Millbrae Avenue via the Airport International Terminal
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model		
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	Nearby Intersections Included	Notes
El Camino Real	Hickey Blvd.	S	0.51	A	2,755	0.65	B	3,177	CALINE4	none	
Rollingwood Dr./ I-280 SB ramps	Sneath Ln.	S	?	?	?	?	?	?	CAL3QHC	none	
Mission Rd.	Evergreen Dr.	A	-	B	986	-	A	949	CALINE4	none	
Mission Rd.	New street	A	-	C	1,564	-	B	1,163	CALINE4	none	
El Camino Real	New street	S	0.52	A	2,240	0.44	A	2,685	CALINE4	none	
Mission Rd.	Grand Av.	A	-	B	1,308	-	B	1,179	CALINE4	none	
Chestnut Av.	Grand Av.	S	0.64	B	1,819	0.91	E	2,269	CALINE4	none	
Mission Rd.	Oak Av.	U	-	A/A	653	-	A/A	494	CAL3QHC	none	
El Camino Real	Arroyo Dr.	S	0.32	A	2,299	0.43	A	2,873	CAL3QHC	El Camino Real - Westborough Blvd. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
Junipero Serra Blvd.	Westborough Blvd.	S	0.78	C	4,028	0.92	E	5,540	CAL3QHC	none	
El Camino Real	Westborough Blvd.	S	0.64	B	4,064	0.73	B	5,292	CAL3QHC	El Camino Real - Arroyo Dr. Camaritas Av. - Arroyo Dr. Camaritas Av. - Westborough Blvd.	
El Camino Real	So. Spruce Av.	S	0.47	A	3,194	0.64	C	4,343	CAL3QHC	none	
El Camino Real	Sneath Ln.	S	0.65	B	4,514	0.91	E	6,340	CAL3QHC	none	
Huntington Av.	Sneath Ln.	S	0.15	A	755	0.26	A	1,009	CALINE4	none	3-way, signalized intersection; Huntington Av. realigned to south.
El Camino Real	San Bruno Av.	S	0.39	A	3,264	0.56	A	4,351	CAL3QHC	none	Existing geometry assumed in 1993; planned improvements incorporated in 1998, 2000, and 2010.
San Mateo Av.	San Bruno Av.	S	0.73	C	2,576	0.59	A	2,644	CAL3QHC	Huntington Av. - San Bruno Av. 2nd Av. - San Bruno Av. San Mateo Av. - Huntington Av.	

Table D-8
Alternative VI – Millbrae Avenue via the Airport International Terminal
Intersection Traffic and Geometry Conditions

			1998 Peak-Hour Traffic Conditions								
		Signal	AM			PM			Model		
N/S Street	E/W Street	Control	V/C	LOS	Volume (vph)	V/C	LOS	Volume (vph)	Used	Nearby Intersections Included	Notes
2nd Av.	San Bruno Av.	U	-	C/B	1,820	-	E/B	2,082	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. San Mateo Av. - Huntington Av.	
San Mateo Av.	Huntington Av.	U	-	E/A	1,548	-	F/A	1,563	CAL3QHC	Huntington Av. - San Bruno Av. San Mateo Av. - San Bruno Av. 2nd Av. - San Bruno Av.	
Huntington Av.	Angus Av.	A	-	B	869	-	D	1,309	CALINE4	none	
El Camino Real	Center St.	S	0.40	A	2,886	0.49	A	3,621	CALINE4	none	
El Camino Real	Millbrae Av.	S	0.93	E	6,685	0.87	D	6,896	CAL3QHC	none	Existing geometry assumed in 1993. Planned improvements (Millbrae Av. grade separation) incorporated into intersection geometry in 1998, 2000, and 2010. Planned improvements not incorporated into traffic volumes.
Rollins Rd.	Millbrae Av.	S	0.66	B	5,875	0.68	B	5,908	CAL3QHC	none	Millbrae Av. and Rollins Rd. widened. Millbrae BART Station to immediate north
El Camino Real	Murchison Dr.	S	0.85	D	4,342	0.72	C	4,432	CAL3QHC	El Camino Real - California Dr.	
California Dr.	Broadway	S	0.85	D	3,005	0.89	D	3,068	CAL3QHC	none	

Notes:

1) Signal control: S–signalized; U–unsignalized (stop sign on minor road only); and A–all-way stop.

2) V/C is volume to capacity ratio. V/C is not calculated for unsignalized or all-way stop intersections.

3) LOS is intersection level of service. A single value is determined at signalized and all-way stop intersections. At unsignalized intersections, LOS is determined for each critical movement (left turns from the major street, all movements from the minor street); the first value given is the LOS for the worst-case critical movement, and the second value is the LOS for the dominant (largest volume) critical movement.